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EdWorkingPaper No. 24-996

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VERSION: July 2024

Suggested citation: Leighton, Margaret, Anitha Martine, Julius Massaga, and Emmanuel Bunzari. (2024). The Causal Effect of Parenting Style on Early Child Development. (EdWorkingPaper: 24-996). Retrieved from Annenberg Institute at Brown University: https://doi.org/10.26300/g5vt-7b40

The Causal Effect of Parenting Style on Early Child Development *

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July 15, 2024

Abstract

This paper presents causal evidence on the impact of parenting practices on early child development. We exploit exogenous changes in nurturing care induced by a parent training intervention to estimate the impact of nurturing parenting practices on child outcomes. We find a large and significant impact measured at age two; in contrast, at age four nurturing care has only a modest, and imprecisely estimated, impact on child outcomes. This is despite the fact that the intervention induced substantial changes in parenting practices at both ages. The differential relationship between child development and nurturing care at ages two and four explains the fade-out in treatment effects for the intervention as a whole: although parents continued to respond, their response no longer had the intended effect on child outcomes.

*The authors gratefully acknowledge the team from Save the Children International Tanzania, Save the Children UK and ADP Mbozi who designed and carried out the intervention underpinning this research, in particular John Tobongo, Emily Weiss, Kirsten Mucyo, Richard Germond, and Celine Sieu. The project would not have been possible without the participation of the Government of Tanzania and the caregivers and children in Songwe region. The authors thank Alison Andrew, Sonia Bhalotra, Deborah Cobb-Clark, Thomas Dohmen, Orla Doyle, Nina Drange, Almudena Sevilla and seminar attendees at the European Society for Population Economics conference, Save the Children, the University of St Andrews and the Workshop on Education Economics and Policy (Trondheim) for helpful comments and discussions. Research assistance by Lauren Davis, Lawrence Ho, Himangshu Kumar and Peter Lowley is gratefully acknowledged. Data collection was approved by the Tanzania Commission for Science and Technology, with ethical clearance granted by the National Institute of Medical Research (NIMR/HQ/R.8a/Vol.IX/2670, Vol.IX/3228 & Vol.IX/3843). This research has been approved by the St Andrews' University Teaching and Research Ethics Committee (EC15104). ML gratefully acknowledges research funding from the Royal Society of Edinburgh Research Re-Boot (Covid-19 Impact) Research Grant and the Scottish Funding Council Global Challenges Research Fund. Conflict of interest statement: ML has worked as a paid consultant to Save the Children on other projects. Contribution statement: ML conceptualization, literature review, data analysis, interpretation and writing of the manuscript. AM and ML: evaluation study design and data collection plan. JM: principal investigator for data collection (waves 1 & 2). EB: principal investigator for data collection (wave 3).

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1 Introduction

At the critical early ages where children are laying the foundations of their human capital, the role of the family is unparalleled. A growing consensus in child development identifies nurturing care as the ideal care setting in which a child will thrive: "a stable environment that is sensitive to children's health and nutritional needs, with protection from threats, opportunities for early learning, and interactions that are responsive, emotionally supportive, and developmentally stimulating" (Britto et al. (2017), p91). Yet many of the world's children do not enjoy the benefits of such an upbringing: McCoy et al. (2022) estimate that barely 25% of children aged 3-4 in low-and-middle income countries are receiving minimally adequate nurturing care.

The importance of nurturing care for child development to age three is now widely promoted by international organizations (see, for example, WHO (2018), Clark et al. (2020)). Parent-training programs which target caregivers of children in this age range have measured substantial improvements in child outcomes, at least in the short term (Jeong et al. (2021a)). While modern models of human development give strong indications that nurturing care should continue to promote the development of children at older ages (Black et al. (2021)), empirical evidence with strong causal attribution remains scarce.

This paper estimates the causal effect of nurturing care practices on early child development at ages two and four. We leverage exogenous variation in parenting style induced by a caregiver training intervention implemented over four years in rural Tanzania. The intervention delivered group-based training to caregivers of pre-school aged children using two age-graded curricula focused on nurturing care. Following a cohort of children and their caregivers, our data track parent-child interactions in biannual follow-ups over the course of the intervention. Each survey wave measured child development, as well as collecting data on the home and family interactions.

We find that nurturing care substantially improves child development at age two (0.57 SD improvement in child development for a 1 SD increase in nurturing care); however, it has only a modest and imprecisely estimated effect on child development at age four. This explains the deterioration of the overall treatment effect of the intervention, which become small and statistically insignificant in the second follow-up. Further analysis suggests some important heterogeneity in the developmental return to nurturing care, particularly at age four. Returns to nurturing care are negatively associated with markers of advantage:

socioeconomic status, parental literacy, and less remote location. This suggests that nurturing care may continue to provide protective effect for disadvantaged children, even if the population-level treatment effect declines with age.

Rigorous evaluations of parent training interventions in low- and middle-income countries show that these are successful at improving early child development across a range of domains (Jeong et al. (2021a)). Evidence on the persistence of these improvements beyond the intervention period suggests that treatment effects suffer from rapid fade-out (Jeong et al. (2021b)). In this sense, parent training resembles other interventions: a meta-analysis of early childhood education evaluations published from 1960-2007 finds that gains in cognitive outcomes decline sharply from the end of the intervention (Bailey et al. (2017)). There are significant exceptions, however, that demonstrate that persistence is possible: a parent training intervention in Rwanda measured gains three years post (Justino et al. (2023)), while an intensive age 0-5 home visiting and parenting program in Ireland still showed substantial cognitive improvements at age nine (Doyle (2022)).

Our paper makes three contributions to the literature. First, we present 'reduced form' treatment effect estimates for an intervention which sought to improve child development via caregiver training, with a specific mission to scaffold early gains with ongoing programming. At age two, the intervention led to improvements in child development of 0.31 SD (intention-to-treat), but at age four the treatment effect was only one third this size, and statistically insignificant. These estimates are of particular interest due to the long duration of the intervention: while the dosage of treatment for any caregiver was small (the main intervention included 2 parenting courses of 8-10 weeks, normally taken several years apart), the intervention ran continuously in treatment areas for four years. This low-intensity, long-duration intervention is unusual in the literature, and sheds light on how treatment effects evolve over time in a setting where treatment is ongoing.

Second, by leveraging an intervention designed to influence parenting style, we are able to estimate the causal effect of nurturing care on child development. We do so at two developmental stages, one in the 'first 1000 days' (where we find a large causal effect of nurturing care on child development) and one in the 'next 1000 days' (where we do not). While the importance of parenting practices is increasingly recognized in both academic and policy circles (WHO (2018), Black et al. (2021)), exogenous variation is rare in nature. Our study contributes strong evidence for the importance of nurturing care at the youngest

ages, while highlighting areas for further investigation as the nurturing care framework is extended to later stages of childhood.

Finally, we are able to provide suggestive evidence about which aspects of parenting are driving our results. In the past decade, significant progress has been made in uncovering the mechanisms behind treatment effect estimates in early child development. Mediation analysis techniques introduced by Hicks and Tingley (2011) and Heckman et al. (2013) have allowed researchers to decompose the overall impact of an intervention into component parts due to changes in intermediate outcomes (Doyle (2020); Justino et al. (2023)), under some conditions with a causal interpretation. While our exogenous variation can be summarized by a single channel of effect – the intervention was designed to deliver nurturing care via caregivers – our rich data on parent-child interactions allows us to explore in what ways parenting is most influential.

We break our measure of nurturing care into component indicators and carry out a mediation analysis to understand how parenting practices mediate the overall ('reduced form') effect of the intervention. Our mediation analysis cannot be interpreted causally, but provides suggestive directions of effect. At younger ages, mother's positive parenting, father's interactions with the child, and diversity of toys are all significant mediators, explaining 58.3% of the intervention treatment effect. At four years, however, some of our mediators show unexpected relationships with child development: negative discipline by the mother is positively related to child outcomes, while some other positive measures of nurturing care show a (statistically insignificant) negative effect. The overall treatment effect of the intervention at this age is not statistically significant: the mixed signs on different components of nurturing care suggests a complicated story may underlie this null result.

The remainder of the paper proceeds as follows. Section 2 presents our theoretical framework and describes the underlying intervention. Section 3 provides an overview of the data, including balance checks at each follow-up. Section 4 describes the econometric approach. Section 5 presents the main results, with extended results (including heterogeneity and mediation analysis) in Section 6. Section 7 concludes.

2 Theory & Intervention

2.1 Parenting style

In 2017, the Lancet published a series of articles reviewing the evidence for scaling-up early child development interventions. The expert panel of authors drew on advances in neuroscience and longitudinal studies to conclude that successful interventions must be anchored in nurturing care: (Britto et al. (2017), Black et al. (2017)), including theoretical and cross-sectional (e.g., Shonkoff et al. (2012); Noble et al. (2015)) as well as impact evaluation studies (e.g., Maluccio et al. (2009); Gertler et al. (2014)).

These landmark papers fueled a wave of interest in parenting programs, modern iterations of which tend to draw heavily on the nurturing care framework. Parenting interventions are based on a train-the-trainer model: rather than work directly with children, they seek to intervene in the parent-child relationship, fostering practices that are associated with positive child outcomes. This model is particularly attractive in low-resource settings with poor early years outcomes, as it offers a cost-effective means of reaching children from infancy. The body of evidence around such interventions suggests these can improve early child development, at least in the short term (Jeong et al. (2021a,b)). However, while such evidence indirectly validates the importance of parent-child interactions, it does not establish the relationship between nurturing care and child outcomes.

The field of family economics provides a theoretical basis from which to formalize the role of parenting practices in the formation of human capital. In addition to advances in estimating the production function of early child development (see, e.g., Attanasio et al. (2020); Cunha et al. (2010)), a growing literature seeks to understand the impact of parenting style on child outcomes (see, e.g., Doepke and Zilibotti (2017); Cobb-Clark et al. (2019); Zumbuehl et al. (2020)). In a pioneering paper, Doepke and Zilibotti (2017) unite a framework of parenting styles from developmental psychology with an economic understanding of parents as simultaneously altruistic and paternalistic towards their children. Parents in the Doepke and Zilibotti model can influence their children's choices either by seeking to shape their preference, or by directly constraining these. These alternative approaches align with two of four established parenting styles: 'authoritative' parents seek to shape preferences, while 'authoritarian' parents restrict choices to impose the ones they like. 'Permissive' parents allow children to choose according to their individual preferences, while 'neglectful' parents

are uninvolved.

Nurturing care, which promotes an engaged and affectionate relationship between parents and their children, can be thought of as one of two dimensions determining these four parenting styles. To bring these concepts to data, Doepke and Zilibotti (2017) place parenting styles into four quadrants based on whether parents are *demanding* and *supportive*.[1] Nurturing care is not prescriptive about the demands one ought to place on one's children: it emphasizes responsive caregiving and support. Nurturing care can therefore be understood, not as one of these four parenting styles, but as a component of each. On the extensive margin, increasing nurturing care practices at the population level could shift some parents from authoritarian to authoritative, and others from neglectful to permissive. But many changes will be on the intensive margin, shifting parenting style towards greater support.

2.2 The intervention

The data used in this paper come from an intervention designed by Save the Children to promote child development and school readiness in low-resource, low-academic achievement environments. The program was designed to support children from birth through to a successful transition to school. This was to be achieved primarily through community-based caregiver training sessions, with an emphasis on supporting caregivers to provide stimulation and nurturing care at home.[2] For older children, the focus of parenting sessions shifted to the transition to school.

These caregiver focussed activities were complemented in the final year of the intervention by teacher professional development for pre-primary teachers. Although younger children may enroll if they are ready, pre-primary education is only compulsory from age 5 (Libent-Mabagala and Shukia (2019)); by the last wave of data collection, our sample of 4-5 year old children were just becoming eligible for pre-primary, and therefore this aspect of the intervention had little opportunity of affecting them.[3] We abstract from the pre-

[1] Authoritative (helicopter) parents are both supportive and demanding, while authoritarian parents are demanding, but not supportive. Permissive parents are supportive but not demanding, and neglectful parents are neither.

[2] The intervention included some community-level aspects as well, such as community theatre, as well as advocating for early child development among local authorities. These are complementary to the core training sessions, in that they also target caregivers or the caregiving environment rather than seeking to promote child development by working with children directly.

[3] In our sample, 15% of children have ever attended pre-primary (T=19% vs C=12%, p=0.000), with 12% attending 5 times a month or more (T=13% vs C=10%, p=0.051). Attendance figures can be found in Appendix Table 14.

primary aspect of the intervention in this paper, although we revisit the role of pre-primary attendance in the extended analysis.

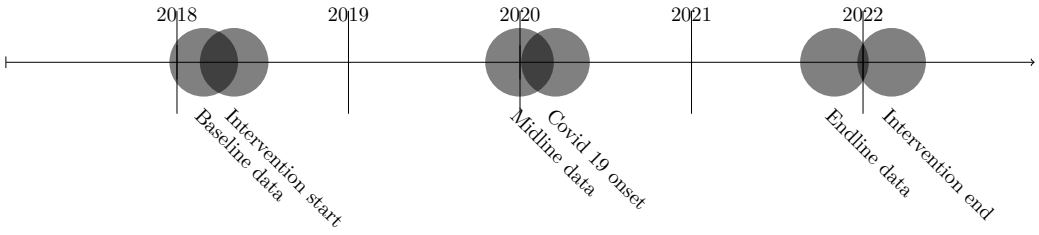
The intervention also sought to reduce inter-partner violence (IPV). The project theory of change posited that violence towards children and IPV have a shared root, and that to promote a safe and nurturing home environment, the root cause of violence must be addressed. To test this, one half of the treatment areas received additional caregiver and community training targeting violence in the home. Analysis from the first and second follow-up surveys finds no difference in discipline or IPV measures across these two treatment arms (Leighton et al. (2023); Omarshah et al. (2022)). We therefore focus on the nurturing care parenting sessions, which were common to both arms, as the intervention.

Scale-up was central to the program design, which strove to be low-cost and replicable. Two nurturing care training curricula were developed in collaboration with local stakeholders: one targeting caregivers of children aged 0-3, and the other ages 4-6. These curricula were delivered by trained community members through weekly group meetings of 20-25 attendees. Each cycle of sessions for 0-3 year-olds ran for 10 weeks, while the 4-6 sessions ran for 8 weeks. Ideally a caregiver from each household would follow each cycle once, when their child was of the target age. The session content was specific to each age range, but both curricula revolved around responsive caregiving, early learning, nutrition, and child protection (an overview of the curriculum coverage can be found in Appendix C, including the five additional sessions focussed on IPV reduction). Families identified as being particularly vulnerable were also offered two home visits per cycle.

The program was launched early in 2018 in Mbozi District, part of the Songwe Region of Tanzania, through a partnership between Save the Children and local NGO ADP Mbozi. The project rolled out intervention components sequentially over a four-year period, starting with caregiver training sessions, and adding teacher and school components towards the end of the intervention period. Data were collected at baseline, with follow-ups after two and four years (see Figure 1). The first follow-up was completed several month before Covid-19 was declared a global pandemic. program activities continued in an adapted fashion during the pandemic. Adaptations included shorter sessions, smaller groups, and content modifications to cover Covid-safe practices and how to cope with school closures.[4] The second follow-up was carried out at the end of 2021, as the program activities were wrapping up.

[4]Schools in Tanzania were closed from 16 March - 29 June 2020 (Oza and Cilliers (2021)).

Figure 1: **Intervention and data collection timeline**



The caregiver sessions were delivered by volunteer community facilitators. Prospective facilitators were identified by community leaders and government officials based on their skills (literacy, community mobilization and facilitation experience) and interest; final selection was made after a short interview. Facilitators received a monthly stipend of 30,000 shillings (approximately £10.40 in 2017), and underwent an initial five day training. A refresher training (approximately one day of training for each 3-5 sessions) was also delivered at the start of each cycle.

3 Data

3.1 Study design and data collection

This paper relies on evaluation data collected by Save the Children. The intervention was set-up with a quasi-randomized design: 8 intervention wards were selected to cover the geographic and socio-economic diversity of Mbozi District, and 8 control wards were selected based on their similarity and geographic proximity to the intervention wards (maps of the study area can be found in Appendix Figure 2). A baseline sample of 2,289 infant-caregiver pairs were initially surveyed prior to the start of the intervention (T=1,153, C=1,136). The criteria for inclusion was age of sample child between 4-12 months old. 1,705 members of the initial sample were re-interviewed in the first follow-up, and 1,584 at the second. In total, 1,387 child-caregiver pairs provided responses in each of the three waves (just over 60% of the original sample).

Each survey wave collected data on both the sample child and their primary caregiver (usually their mother). During the first two waves, when the children were under three years old, child development data was collected using the long form of the Caregiver Reported Early Development Instrument (CREDI); in the final wave, when the children were 4-5 years

old, they were directly assessed with the International Development and Early Learning Assessment (IDELA) tool. These tools, which can be implemented at low-cost without expert enumerators, have been validated in multiple contexts (for CREDI, see e.g., McCoy et al. (2018), Munoz-Chereau et al. (2021), McCoy et al. (2021); for IDELA, see Pisani et al. (2018), Wolf et al. (2017)). Both tools generate an overall measure of child development, as well as set of domain-specific components.[5]

The caregiver survey covered a wide range of topics about the child and their family, including basic demographics, home environment, activities done with the child, the nature of interactions between child and caregivers, as well as a measure of socioeconomic status (SES). Many of these questions are asked separately for the mother, father and other caregiver (e.g., activities and interactions): in these cases the responding caregiver reported answers for each other adult separately.

3.2 Variables of interest

3.2.1 Final and intermediate outcomes

Our study includes both a final outcome (child development) and an intermediate outcome (nurturing care practices adopted by parents). To capture child development we use the overall measures generated by the CREDI (age 0-1 and age 2-3) and the IDELA (age 4-5). As the measures do not have a natural interpretation, in each survey wave we normalize these data with respect to the control group mean and standard deviation. The distribution of these measures at each wave is shown in Appendix Figure 3.

The change of tool between the second and third wave of data collection raises some concerns about the comparability of the measures: as these tools are designed for non-overlapping age ranges, we cannot test this directly. To validate the measures, we test the association of both measures with common predictors of child outcomes: household SES, parental literacy, child age and gender. We also correlate the measures at each wave with each other.

This validation exercise suggests that the measures are broadly comparable. IDELA measures at age 4-5 show a similar correlation with age 2-3 CREDI measures as do CREDI measures between ages 0-1 and 2-3 (0.135 vs 0.154, respectively, Appendix Table 7). CREDI

[5]The CREDI subdomains are motor, cognitive, language, and socioemotional. The IDELA subdomains are motor, literacy, numeracy and socioemotional.

at age 2-3 and IDELA at age 4-5 show the expected associations with demographic and family variables: the relationship with SES is similar across the measures (0.0925 vs 0.0646), while some associations are stronger in IDELA (girls perform 0.154 SD better than boys, whereas performance was similar across genders in CREDI; parental literacy has a stronger association with IDELA outcomes than CREDI; Appendix Table 8). Given that gaps in achievement are liable to grow over time, these modest differences are not unexpected. Finally, we estimate the association between the measures, controlling for the predictors: these look very similar to the pairwise correlations (Appendix Table 8, columns 4-7).

To measure nurturing care practices, we aggregate data across seven subsections of the caregiver survey: interactions with mother and father, diversity of toys in the house, positive parenting actions of mother and father, and negative disciplinary actions of mother and father. The data on interactions cover the frequency with which the parent does any of nine different activities with the child, such as reading books, singing songs, playing counting games. The index of diversity of toys sums the answers to nine yes/no questions on the presence of certain categories of toys, e.g., household objects, toys from a shop, toys with at least two pieces. The data on positive parenting and negative disciplinary practices cover 14 different kinds of interaction, such as hugging, praising, listening to the child (positive) or yelling at, hitting or shaking the child (negative).[6] We create an index within each section, and then aggregate these, giving equal weight to each section. The resulting measure is an index out of 100; when used in analysis we normalize this index against the control group mean and standard deviation from the same survey wave.

Table 1 summarizes (normalized) child development and the index of nurturing care over the three waves of data collection. While we cannot comment on absolute measures of child development, we can see that the gap in development scores between treatment and control peaks at age two (0.34 SD), but remains modest at age four (0.14 SD). Nurturing care practices increase monotonically as the child ages in both treatment and control. In the control group, the baseline nurturing care measure of 47 (out of a maximum possible 100) rises to 52 at age two and 56 at age four; the trend is similar in the treatment group, but the change is much larger between ages 0 and 2 than between 2 and 4.

[6] For all but the negative parenting questions, a score of 0 on the index represents the most limited application of nurturing care: parents who never do any activities with their children, who have no toys in their house, and who never provide affection and support. We therefore reverse the scales of the negative discipline questions so that 0 represents a frequent application of this non-nurturing practice. A 0 on the negative parenting index would represent a parent who yells, hits, shakes, etc. their child at the highest measured level of frequency. A top score on this reversed index would be a parent who never does any of these things.

Table 1: **Overview of outcomes**

	Treatment			Control		
	Mean	SD	N	Mean	SD	N
Age 0						
Nurturing Care	47.80	8.34	584	46.53	7.64	614
Standarised ECD	0.06	1.09	677	0.00	1.00	710
Age 2						
Nurturing Care	58.18	12.72	584	52.20	10.24	614
Standarised ECD	0.34	1.10	677	0.00	0.97	710
Age 4						
Nurturing Care	59.96	10.85	584	55.76	9.69	614
Standarised ECD	0.16	1.21	677	0.02	1.01	710

Notes: summary statistics from the panel of caregivers and children with valid outcome measures in all three waves. Child development (ECD) scores are normalized to the full sample control group in each wave; nurturing care scores are measured on a scale from 0-1, where 1 is a perfect score on all components of the index.

This upwards drift partly reflects the types of questions included in the index: many types of interactions (such as playing counting games, listening to what the child thinks) are more suited to older children than to infants. In a different sense, this is also true of the negative disciplinary actions, which also increase with the age of the child: the types of situations that lead to parents yelling at, shaking or hitting their children are more likely to occur with children aged 2 and 4 than with infants. The difficulty in obtaining a leveled measure of nurturing care which is stable across ages motivates our decision to normalize this measure against the control group in each wave for our analysis.

Two limitations to these data should be noted. First, with the exception of the IDELA scores, all variables are self-reported by the responding caregiver. Second, and relatedly, some of the variables could be subject to social desirability bias. Without observational measures to compare against, we are unable to assess the severity of any such biases; however, it is important to note that there was no incentive for respondents to give any particular answers in the survey. Respondents did report non-trivial levels of socially undesirable behaviors (e.g., inter-partner violence, violence towards children), in both the treatment and control groups: this suggests that social desirability was not entirely driving their responses.

Table 2: **Balance in pre-treatment characteristics**

				Baseline						Panel		
		Control		Treat	t-test diff	norm diff		Control		Treat	t-test diff	norm diff
Variable	N	Mean/SE	N	Mean/SE	(1)-(2)	(1)-(2)	N	Mean/SE	N	Mean/SE	(1)-(2)	(1)-(2)
ECD baseline	1136	-0.000	1153	0.028	-0.028	-0.026	618	0.014	553	0.033	-0.020	-0.019
		(0.030)		(0.033)				(0.040)		(0.047)		
Nurturing care baseline	1127	46.959	1128	47.730	-0.771**	-0.096	618	46.552	553	47.801	-1.249***	-0.156
		(0.232)		(0.245)				(0.310)		(0.354)		
First child	1136	0.305	1152	0.344	-0.039**	-0.084	618	0.243	553	0.235	0.008	0.018
		(0.014)		(0.014)				(0.017)		(0.018)		
Female respondent	1136	0.934	1153	0.963	-0.029***	-0.130	618	0.929	553	0.958	-0.030**	-0.127
		(0.007)		(0.006)				(0.010)		(0.008)		
Girl child	1136	0.527	1153	0.509	0.018	0.036	618	0.550	553	0.524	0.026	0.052
		(0.015)		(0.015)				(0.020)		(0.021)		
Age in months	1136	7.602	1153	7.667	-0.065	-0.024	618	7.642	553	7.569	0.073	0.026
		(0.074)		(0.087)				(0.103)		(0.127)		
SES (in sd)	1136	-0.000	1153	-0.050	0.050	0.049	618	-0.055	553	-0.096	0.042	0.042
		(0.030)		(0.030)				(0.039)		(0.043)		
Young mother	1136	0.527	1153	0.558	-0.030	-0.061	618	0.464	553	0.476	-0.011	-0.022
		(0.015)		(0.015)				(0.020)		(0.021)		
Mother literate	1136	0.832	1151	0.831	0.000	0.001	618	0.828	553	0.852	-0.023	-0.063
		(0.011)		(0.011)				(0.015)		(0.015)		
Father literate	1134	0.919	1137	0.908	0.011	0.040	618	0.911	553	0.904	0.007	0.024
		(0.008)		(0.009)				(0.011)		(0.013)		
Dist to highway	1134	18.393	1097	9.558	8.835***	0.910	618	19.628	553	9.874	9.754***	1.012
		(0.303)		(0.200)				(0.386)		(0.281)		
Dist to any road	1134	1.586	1097	1.526	0.060	0.031	618	1.730	553	1.421	0.309***	0.170
		(0.059)		(0.057)				(0.080)		(0.068)		
Dist to nearest town	1134	23.148	1097	19.896	3.252***	0.373	618	24.606	553	20.490	4.116***	0.502
		(0.312)		(0.178)				(0.377)		(0.253)		

Notes: Standard errors in parentheses. P-value regards a t-test of equal means between control and treat: * $p < 0.10$ ** $p < 0.05$, *** $p < 0.01$.

3.2.2 Other variables

We retain a set of other variables as covariates. Table 2 presents the balance of pre-treatment measures of outcomes and covariates, both for the full baseline sample and for the panel of observations with complete records in each wave. While there is good balance in both the original sample and the panel for most characteristics, two aspects of imbalance are particularly important to note. Both at the first wave, and even more so within the panel, the pre-treatment level of nurturing care is higher in the treatment group than in the control group. Second, across three measures of remoteness (distance to the nearest road, town, or highway), the control group is more remote on average than the treatment group. In response to this, and to leverage the variation in our data most efficiently, we will control for the baseline levels of all the variables shown in Table 2. Since changes in nurturing care are the core of our analysis, the baseline imbalance in this variable should nevertheless be kept in mind.

4 Empirical framework

4.1 Estimation strategy

Our goal is to estimate the causal effect of nurturing care practices on early child development outcomes. In observational data, there are reasons to be concerned that nurturing care is endogenous to characteristics of the child-parent dyad that are causally related to child development in their own right. This could be due to shared influences affecting both parents and children (e.g., poverty or living condition), or parental characteristics that may happen to be associated with the adoption of nurturing care practices (e.g., attentiveness to the child, parental time constraints).

To overcome the potential endogeneity of nurturing care, we exploit changes in parenting style induced by the caregiver training intervention. Since parents could not choose to have their area allocated to treatment, we use treatment assignment at baseline as an instrument for changes in parenting style. We then estimate the causal relationship between nurturing care and child development using this exogenously driven change in parent behavior.

4.2 Estimating equations

We proceed in three steps. The theory of change that motivates this study is that the intervention changed nurturing care practices, and that nurturing care improves child development. We first check the reduced form of this equation: what is the effect of the intervention on child outcomes? We estimate this as follows:

$$Y_{it} = \alpha_0 + \alpha_1 \text{treat}_i + \alpha_2 Y_{i1} + \delta X_{i1} + \epsilon_{it}, \tag{1}$$

where Y_{it} is overall child development score measured at waves $t = 2, 3$; *treat* is a binary variable; and X_{i1} the pre-treatment control variables. These controls, which are summarized in Table 2, include socio-demographic characteristics of the child and their parents, measures of remoteness, and baseline values of nurturing care practices. The baseline child development score, Y_{i1}, is also controlled for. The reduced-form treatment effect is estimated as $\hat{\alpha_1}$.

We next estimate the causal effect of nurturing care on child development. We contrast a

'naive' ordinary least squares (OLS) approach (estimating the association of nurturing care with child outcomes in our study population) with an instrumental variables (IV) strategy, exploiting changes in nurturing care induced by the intervention. The OLS approach consists in estimating the following equation:

$$Y_{it} = \nu_0 + \nu_1 N_{it} + \nu_2 Y_{i1} + \gamma X_{i1} + \epsilon_{it}, \tag{2}$$

where N_{it} is nurturing care in period t, and the other variables are defined as before. We estimate Equation 2 on the control group only, to focus on the relationship between nurturing care and child development absent any intervention: the coefficient of interest is the estimate $\hat{\nu_1}$. Finally, our instrumental variables strategy is implemented through two-stage least squares as follows:

$$N_{it} = \mu_0 + \mu_1 \text{treat}_i + \phi X_{i1} + \epsilon_{it} \tag{3}$$

$$Y_{it} = \beta_0 + \beta_{2SLS} \hat{N}_{it} + \beta_2 Y_{i1} + \Omega X_{i1} + \epsilon_{it} \tag{4}$$

where N_{it} is the change in nurturing care, and $\hat{N_{it}}$ is the change in nurturing care predicted by treatment assignment and covariates. Treatment status $treat_i$ is the instrument excluded in Equation 4. The coefficient of interest is $\hat{\beta_{2SLS}}$, the causal effect of treatment-induced change in nurturing care on child development outcomes.

4.3 Identification

To interpret our estimated $\hat{\beta_{2SLS}}$ from Equation 4 causally, in addition to a valid first stage, we need the standard IV assumptions to hold: independence, and the exclusion restriction. The independence assumption is that the instrument is as good as randomly assigned, in other words, it is unrelated to any relevant omitted variables. Two aspects of our data help us achieve this. First, the intervention, while not randomly assigned, was assigned at a coarse geographical area largely orthogonal to individual characteristics (see Table 2). Although the balance in covariates at baseline is not perfect, it is quite strong across demographic variables. Second, we have rich pre-treatment covariates, which help us control for any remaining differences between treatment and control.

The exclusion restriction requires that the instrument (treatment status) affects the outcome (child development) only through its effect on the endogenous regressor (nurturing care). This would be violated if the intervention had a direct effect on children, or if it affected child development through an alternate pathway. While the first can largely be ruled out, given that there was little to no direct interaction of the intervention with the children in our sample, the second raises some concerns. While the vast majority of the intervention elements fall under the umbrella of promoting the child's nurturing care environment, as discussed in Section 2 there were other aspects to the intervention as well, such as teacher training. While we have provided some evidence why these other aspects were unlikely to have impacted the children in our panel, it cannot be entirely rules out.

Finally, we must keep in mind that our estimates of the causal effect of nurturing care on child development are local average treatment effects. The 'local' group we are able to study with this approach are those parents whose parenting practices changed as a results of the program. This group is of particular interest for policy, but they do not necessarily represent the average parent.

5 Results

5.1 Reduced form

Table 3 presents results from estimations of Equation 1: the 'reduced form' impact of the intervention on child development. Columns (1) and (2) estimate the impact of the intervention at age two (as previously reported in Leighton et al. (2023)), while Columns (3) and (4) estimate the impact at age four. Even-numbered columns, which include the full set of control variables, show our preferred specification.

While the intervention shows a large and statistically significant treatment effect at age two, with average child development scores 0.31 SD higher in the treatment group compared with control, at age four the point estimate has dropped by 2/3 and the treatment effect is statistically insignificant. While our setting, where the intervention is ongoing between the two time periods, is somewhat unique, this fade-out has been observed in other early childhood interventions with follow-up one to two years after the end of treatment (Andrew et al. (2018); Ozler et al. (2018)).

Table 3: **Reduced form: treatment effects on child development**

	(1) ECD age 2	(2) ECD age 2	(3) ECD age 4	(4) ECD age 4
Treat	0.308***	0.306***	0.154	0.0981
	(0.0696)	(0.0929)	(0.114)	(0.109)
ECD age 0	0.162***	0.166***	0.0792**	0.0761**
	(0.0325)	(0.0325)	(0.0286)	(0.0269)
Nurture age 0	0.0671***	0.0518**	0.0516**	0.0412*
	(0.0210)	(0.0205)	(0.0205)	(0.0202)
Controls		X		X
Observations	1505	1505	1360	1360

Notes: Standard errors (clustered at the Ward level) in parentheses, * $p < 0.10$ ** $p < 0.05$, *** $p < 0.01$.

5.2 Causal effect of nurturing care

We now turn to estimating the causal effect of nurturing care on early child development. Table 4 summarizes our results. Panel A of the table first presents OLS estimates of the relationship between nurturing care and child development at ages zero, two and four, and then IV estimates at ages two and four. Panel B presents the first stage equations for the IV estimates, showing the effect of the treatment on nurturing care.

OLS estimates (Columns (1)-(3) of Panel A) show an association between nurturing care and child outcomes at all ages. Noting that our primary relationship of interest is between contemporary nurturing care (which is our best estimate of the child's recent environment) and child development, this association is statistically significant at each age, but of variable strength. In the first year of life, 1 SD increase in nurturing care is associated with 0.11 SD higher development scores, while at age two this has increased to 0.33 SD. At age four, this has fallen somewhat to 0.27 SD.

The IV estimates in Columns (4) and (5) suggest a more changeable relationship between the two variables. The causal estimate of a 1 SD increase in nurturing care at age two is 0.57, while at age four this has dropped to a statistically insignificant 0.21 SD. The first stage estimates in Panel B suggest that this decline is not due to a dramatic change in the effect of the intervention (our instrument) on nurturing care: while the effect size declines slightly, the intervention succeeded in increasing nurturing care in both periods (by 0.55 SD in the first and 0.45 in the second).

Comparing the OLS and IV estimates provides some insight into the endogeneity prob-

Table 4: **Effect of nurturing care on child outcomes**

	OLS			2SLS	
PANEL A	(1)	(2)	(3)	(4a)	(5a)
	ECD age 0	ECD age 2	ECD age 4	ECD age 2	ECD age 4
Nurture age 0	0.114**	0.0610	0.0208	0.0389*	0.0272
	(0.0432)	(0.0351)	(0.0219)	(0.0211)	(0.0220)
Nurture age 2		0.327***		0.569***	
		(0.0391)		(0.159)	
Nurture age 4			0.270***		0.219
			(0.0239)		(0.219)
ECD age 0		0.148***	0.0948***	0.130***	0.0595*
		(0.0401)	(0.0195)	(0.0366)	(0.0326)
Controls	X	X	X	X	X
Observations	1124	782	733	1505	1360
				First stage	
PANEL B				(4b)	(5b)
				Nurture age 2	Nurture age 4
Treat				0.551***	0.446***
				(0.0593)	(0.0772)
ECD age 0				0.0662***	0.0753**
				(0.0201)	(0.0285)
Nurture age 0				0.0222	0.0648**
				(0.0180)	(0.0292)
Controls				X	X
Observations				1515	1371
R^2				0.083	0.098
F				1032.1	24.38

Notes: Cols 1-3 OLS, Cols 4-5 IV. Standard errors (clustered at the Ward level) in parentheses, * $p < 0.10$ ** $p < 0.05$, *** $p < 0.01$.

lems highlighted in Section 4. Is parenting style related to characteristics of the child-parent dyad that are unobserved in our setting, but which influence child development? At age 2, the OLS estimate of the association between nurturing care and child development is 0.33, while the IV estimate is 0.57. This suggests some negative selection into nurturing care practices: parents who practice more nurturing care with their 2-year-old child have have unobserved characteristics associated with lower child development outcomes.

In contrast, at age 4 the point estimates are quite similar (0.27 from OLS and 0.22 using IV), although the variance of these estimates differs by an order of magnitude and the IV estimates are not statistically significant. At this older age, selection into nurturing care does not appear to be systematically related to omitted variables driving child development: if anything, in contrast to age 2, there is some positive selection at work. Taken together, these comparisons suggest that the endogeneity of parenting style to unobserved parent and child characteristics poses a substantial threat to identifying the effect of parenting practices on child development from cross sectional data, particularly at early ages. Significantly, these relationships seem to change over time, with an attenuation – and possible reversal of direction – of the bias between ages 2 and 4.

6 Extended results

6.1 Analysis by child development domains

Each of our measures of child development can be broken down into several domains: for CREDI these are motor, cognitive, language, and socioemotional, while IDELA covers motor, literacy, numeracy and socioemotional. We replicate the analysis in Table 4 for each component of our child development measures (see Appendix Tables 9 & 10). The estimated effect of nurturing care on the different developmental domains at age 2 is highly consistent, ranging from 0.43 (motor) to 0.58 (language). At age 4, the different domains show a much more diverse pattern: like the overall score, nurturing care has a statistically insignificant effect on most domains. Literacy is the only exception, with a statistically significant treatment effect of 0.42. Point estimates for other domains range from 0.08 (socioemotional) to 0.14 (motor).

6.2 Heterogeneity

Do all children respond similarly to nurturing care? Do increases in nurturing care yield similar returns in child development in different family settings? There are many reasons to expect systematic differences in the effect of nurturing care across different groups. Children have different needs at different times; families also vary in complex ways. We would expect and increase in nurturing care practices to be more influential in some families than in others.

We explore the heterogeneity of the effect of nurturing care on child development across a range of child and family characteristics. We do this by re-estimating variations of Equation 4 with a fully saturated interaction with the characteristic of interest. Specifically, we interact all right hand side variables (including the endogenous regressor and the excluded instrument, as well as the constant) with a variable capturing the aspect of heterogeneity under consideration. We repeat this for each characteristic. For ease of interpretation, we use binary specifications of each heterogeneity variable: where this is not already the case, we split the sample in two and consider the higher and lower halves of the data.

Tables 5 & 6 summarize the results of this exploration, by child and family characteristics respectively. For each regression we report two point estimates: the interaction of nurturing care and the two values of our binary heterogeneity of interest. We also report the Chi-squared statistic (and its p-value) of a test of equality of these two estimates.

Overall, there is little variation in the estimated effect of nurturing care by child characteristics, at either age (Table 5). The notable exception is gender at age 2: the estimates for boys are substantially larger than girls (0.83 vs 0.39), with the difference statistically significant at the 10% level. This difference has disappeared by age 4. For other characteristics, the difference is not statistically significant, and in most cases the point estimates are also fairly similar.

There is more heterogeneity in treatment effects by family characteristics (Table 6). Nurturing care has a much larger effect on ECD at age 2 for children with literate fathers (0.62 vs -0.14), and children living in more remote locations (0.87 vs. 0.45).[7] In contrast, there seems to be a negative association between the treatment effect and mother's literacy (0.82

[7]For ease of interpretation, we create a summary measure of remoteness. This is the first factor in a principal component analysis of our three GPS-based distance measures (distance to highway, distance to any road, and distance to nearest town, plus a hand-coded indicator at the village level. The factor is positively correlated with all four measures.

for literate, vs. 0.54), although the difference is not statistically significant. At age 4, a clearer pattern emerges, with treatment positively associated with most markers of disadvantage. The negative association with mother's literacy strengthens by age 4 and becomes statistically significant (0.82 vs 0.05), while the association with father's literacy, though no longer significant, changes sign to align with mother's. Although none are statistically significant, the point estimates suggest substantially larger treatment effects for those living more remotely, of lower SES and with lower baseline nurturing care scores.

Table 5: **Effect of nurturing care on child development: by child characteristics**

	Age 2				Age 4			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Girls x treat	0.391				0.224			
	(0.124)				(0.290)			
Boys x treat	0.831				0.281			
	(0.285)				(0.200)			
Older x treat		0.635				0.089		
		(0.14)				(0.315)		
Younger x treat		0.489				0.228		
		(0.186)				(0.171)		
First=1 x treat			0.454				0.027	
			(0.208)				(0.329)	
First=0 x treat			0.645				0.285	
			(0.183)				(0.211)	
ECD age 0 high x treat				0.51				0.131
				(0.145)				(0.243)
ECD age 0 low x treat				0.62				0.297
				(0.189)				(0.236)
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Chi2	2.842	0.986	0.871	0.554	0.076	0.47	1.075	0.696
Chi2 p-val	0.092	0.321	0.351	0.457	0.783	0.493	0.3	0.404
N	1505	1505	1505	1505	1360	1360	1360	1360

Notes: each column presents the coefficients of interest from an estimation of Equation 4 fully interacted with a different binary heterogeneity variable. All baseline control variables (not shown) are included. The Chi2 statistics is for a test of equality of the interacted treatment effects. Standard errors (clustered at the ward level) shown in parenthesis.

Overall, our heterogeneity analysis suggests a much more varied effect of parenting style across families than across children, and particularly so at age 4. It is important to emphasize that our exploration here is around heterogeneity in the effect of nurturing on child development: not heterogeneity in the application of nurturing care itself. Our analysis suggests that in some families – specifically those with less education, less income, and living more remotely – a 1 SD increase in nurturing care practices has a larger positive effect on child development than a similar change in other families.

Table 6: **Effect of nurturing care on child development: by caregiver characteristics**

	Age 2						Age 4					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Moth lit=1 x treat	0.54						0.046					
	(0.15)						(0.274)					
Moth lit=0 x treat	0.826						0.822					
	(0.337)						(0.279)					
Fath lit=1 x treat		0.62						0.161				
		(0.156)						(0.249)				
Fath lit=0 x treat		-0.143						0.561				
		(0.209)						(0.413)				
Moth young=1 x treat			0.523						0.14			
			(0.207)						(0.202)			
Moth young=0 x treat			0.673						0.285			
			(0.19)						(0.309)			
Nurture age 0 high x treat				0.528						0.059		
				(0.142)						(0.253)		
Nurture age 0 low x treat				0.62						0.386		
				(0.22)						(0.225)		
SES high x treat					0.553						-0.022	
					(0.208)						(0.302)	
SES low x treat					0.631						0.346	
					(0.177)						(0.213)	
Remote high x treat						0.866						0.418
						(0.23)						(0.154)
Remote low x treat						0.453						-0.049
						(0.139)						(0.333)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Chi2	1.142	8.909	0.325	0.403	0.109	2.88	3.698	0.506	0.433	1.582	1.997	1.929
Chi2 p-val	0.285	0.003	0.569	0.525	0.741	0.09	0.054	0.477	0.511	0.209	0.158	0.165
N	1505	1505	1505	1505	1505	1505	1360	1360	1360	1360	1360	1360

Notes: each column presents the coefficients of interest from an estimation of Equation 4 fully interacted with a different binary heterogeneity variable. All baseline control variables (not shown) are included. The Chi2 statistics is for a test of equality of the interacted treatment effects. Standard errors (clustered at the ward level) shown in parenthesis.

Two sets of channels could explain this pattern. On the one hand, it could be that families spend different amounts with their children based on these characteristics. We would expect families with more educated parents, and those living closer to urban centers, to be more likely to work outside the home: these families would as a consequence also have higher incomes. Nurturing care practices of the mother and father would likely have a smaller effect on their children if the parents spent their days away, compared to if they were with them all day.

On the other hand, investments in nurturing care could have complementarities with the environment in which the children are living. It could be that a nurturing home environment is complementary with free play and exploration, but less so with the strictures of center-based care or pre-primary schooling. While few of our sample children have begun school, pre-primary attendance is positively associated with SES and negatively associated with remoteness (we explore pre-primary attendance in more depth in Section 6.4). It could be that parents are spending similar amounts of time with their children, but the causal effect of nurturing practices varies depending on what the children are doing outside these interactions.

Anecdotal evidence suggests that both of these channels are relevant in this context. Families with parents who work away from the home, perhaps commuting to the local town, spend less time with their children. These children may be cared for by other family members, or may be enrolled in pre-primary or other center-based care earlier than their peers.[8] At school, harsh discipline is commonly used to maintain order: in addition to having a direct effect on children, such an environment could be a particular shock for children coming from homes where nurturing care practices are widely applied.

6.3 Mediation analysis

The nurturing care framework covers many different aspects of parent-child interactions, the intervention therefore sought to influence a multitude of practices and habits. To shed light on which of these elements were most effective at producing improvements in child development, we carry out a mediation analysis. This mediation analysis is focussed on explaining our 'reduced-form' overall treatment effect (Table 3).

In order to consider multiple mediators at the same time, we apply the product-of-coefficients approach put forward by Preacher and Hayes (2008), implemented in Stata following the UCLA: Statistical Consulting Group. The method proceeds in several steps, estimated simultaneously in a seemingly unrelated regression framework. First, the effect of treatment on each mediator is estimated in a separate regression. This is done by estimating Equation 1 with Y_i being the mediator, rather than the child outcome. Next, the main treatment effect regression is re-estimated (Equation 1 again, now with the child outcome back as dependent variable), but now including all the mediators in the regression along with treatment status.

The indirect effect of each mediator is calculated as the effect of the treatment on the mediator (from step 1) times the effect of the mediator on the outcome (the coefficient on that mediator from step 2). The total indirect effect is the sum of the indirect effects of each mediator; the total direct effect is the coefficient on treatment status from the regression in step 2, controlling for all mediators. To facilitate comparisons, we also express each indirect effect as a fraction of the total effect (direct plus indirect).

We explore the mediating effect of the seven component parenting indices which make up our measure of nurturing care (see Section 3.2): interactions with mother and father,

[8] In addition to the need for childcare, early enrollment in school is perceived by some parents to confer an educational advantage.

positive parenting actions of mother and father, negative disciplinary actions of mother and father, and diversity of toys in the home. All regressions control for our baseline control variables (parent and child), with standard errors clustered at the ward level. Standard errors and 95% confidence intervals (bias corrected) for the estimated indirect and direct effects are calculated via bootstrapping (500 replications).

Under some assumptions, the mediation analysis described above has a causal interpretation (see Hicks and Tingley (2011), who implement a single-mediator analysis, for an excellent overview). In particular, causal inference requires that the error terms in the first and second step estimations are uncorrelated. In our context, this is unlikely to hold: omitted variables that influence the mediators are also likely to influence child development directly. We follow previous work (e.g., Doyle (2022)) and present here an exploratory analysis, providing suggestive evidence on the relative importance of different channels of effect across our two time periods.

Tables 12 and 13 in the Appendix present the results of the mediation analysis at ages 2 and 4 respectively. At age 2, only three of the seven variables are found to be statistically significant mediators of the treatment effect: father interactions with the child, mother's positive parenting, and the diversity of toys in the home (Appendix Table 12). All of these have the expected sign, with father interactions and mother's positive parenting explaining 17% and 11% of the total treatment effect, respectively. The diversity of toys in the home is the most substantial mediator, explaining 23.5% of the treatment effect. Overall, the seven mediators explain 58.3% of the total treatment effect.

The mediation analysis at age 4 suggests a very different story (Appendix Table 13). First, it is important to recall that the overall treatment effect at this age is not statistically significant at conventional levels; however, four out of seven mediators have a statistically significant indirect effect on our measure of child development. These signs of these effects are not always as expected. While mother interactions with the child, father's negative discipline and diversity of toys are related to child development in the expected direction, mother's negative discipline shows the opposite sign. Recalling that this measure is reverse-coded, so that an increase in the index implies a reduced use of negative practices, we find that a 1 SD *reduction* in negative parenting by the mother is associated with 0.042 *lower development scores*. While not statistically significant, it is interesting to note that the three other mediators (positive parenting by both the mother and father, and father interactions

with the child) also show an unexpected negative association with child development.

These results give some insight into the change in the relationship between nurturing care and child development across the two age brackets in our data. With the exception of a home environment with a high diversity of toys - which is associated with positive child development at both ages - none of the other six mediators has a consistently statistically significant effect, and a number of the point estimates change sign. This suggests that the changing relationship between nurturing care, as measured in this study, and child development is not being driven by any one single component of our index: rather, it seems that there are wide-ranging changes in how nurturing parent-child interactions support children developing at different ages.

6.4 Pre-primary attendance

One potential threat to our identification strategy is that the intervention may have influenced the early school experience of children in the treatment areas. This could have happened either by affecting the age at which children enroll in pre-primary, or by changing the pre-primary experience itself.

While the program encouraged parents to wait until their child was 5 years old to start pre-primary, we see slightly higher rates of pre-primary attendance in treated vs control areas (13.2% vs 10.1% attend 5 or more times a month, the vast majority of whom are under 5, see Appendix Table 14). This could be an unintended treatment effect: the age 4-6 curriculum included a focus on preparing children for school, which may have made parents keen to begin this new stage with their child.

The intervention also included a schools component, with training for teachers, school leaders, and school management committees. This training was focussed on early years education for primary and pre-primary aged children. This component of the intervention was delayed by the onset of Covid, and only began in the final year of the project. As a relatively small share of children attend pre-primary, and these had been enrolled at the time of the survey for only a short period of time (the school year begins mid-August, and data collection took place in November-December), the direct effect of treatment is likely to be minimal. Nevertheless, children who started pre-primary in the treatment areas could have benefitted from this additional component of the intervention.

We investigate whether our results are driven by pre-primary attendance using two ap-

proaches. First, we explore correlates of pre-primary attendance by predicting this outcome using our baseline covariates, and alternately also including age 2 and 4 child and caregiver outcomes. We then check the robustness of our estimates to several permutations: first controlling alternately for pre-primary attendance and predicted attendance, then dropping alternately those who attend pre-primary, or who have a higher likelihood of attending.

We explore the correlates of pre-primary attendance using the control group only. Appendix Table 15 presents the results, with both 'any' attendance, or regular attendance (more than 5 times per month) as measures of pre-primary enrollment. Columns (1) and (3) control for the baseline (predetermined) demographic covariates, while columns (2) and (4) add child development and nurturing care indices at ages 2 and 4. Across all specifications, older children are more likely to attend; in most specifications, attendance is positively associated with SES and child development scores (lagged and contemporary), and negatively associated with remoteness. Interestingly, there is no association between nurturing care at any age and pre-primary attendance: the coefficients are in many cases quite precisely estimated zeros.

The results of our robustness analysis can be found in Appendix Table 16. Columns (2) and (3) control for (regular) pre-primary attendance, and predicted attendance, respectively. Both measures are associated with higher child development scores, and including them as controls reduces the (still insignificant) estimated effect of nurturing care. Note that pre-primary attendance is potentially endogenous to treatment status (and therefore to our instrumented nurturing care); predicted attendance, which is calculated from the control group only, should not be. Column (4) restricts to the 89% of the sample *not* enrolled in pre-primary, while Column (5) restricts to those with lower predicted probabilities of attending (below 0.2, trimming approximately 14% of the sample), respectively. In these truncated samples, the point estimate of the effect of nurturing care on child development increases to above 0.3, and when dropping those attending pre-primary, the estimate is also statistically significant at the 10% level.

While the endogeneity of pre-primary attendance requires us to be very cautious in interpreting these results, the robustness checks suggest some substantial heterogeneity in the effect of nurturing care on child development based on pre-primary attendance. When dropping the small share of the sample who attend pre-primary regularly, the effect of nurturing care jumps from 0.22 to 0.36, becoming statistically significant. The change in

estimates implies that this part of the sample responds very differently (in fact *negatively*) to nurturing care; in contrast, the remaining bulk of the sample show a substantial positive effect that is now statistically significant.

Do children with highly nurturing home environments suffer when they transition to school, perhaps because the disciplinary methods and strict environment come as too much of a shock? Or do those children who go to school experience a different response to the practices of their parents for other reasons – for example because their parents rarely see their children because they are commuting for work, and send their children to school as a result? It is worth noting that many of the family characteristics associated with a weaker relationship between nurturing care and child development (literate parents, high SES, less remote location) are also correlated with pre-primary attendance (less remote location and SES). Our data are not rich enough to untangle these questions, but they suggest important areas for future research.

7 Conclusion

We estimate the causal return to nurturing care for the promotion of child development at two points in early childhood: ages two and four. Leveraging exogenous changes in nurturing care, we find a 1 SD increase in nurturing care increases child development by 0.57 SD at age two, while the same change at age four has a statistically insignificant effect on average child outcomes. These results contrast with the population-level association between nurturing care and child development, which is statistically significant at all ages, although it is lower at age four than at age two. They align, and provide a partial decomposition of, the overall ('reduced form') treatment effect from a caregiver training intervention: the intervention caused moderately large increases in child development at age 2 (0.31 SD), but at age 4 the treatment effect was 1/3 the size, and statistically insignificant.

It is important to note that the Covid-19 pandemic arrived shortly after the midline data collection: changes in parenting style and in child development between the first and second follow-up therefore occurred during this time of great disruption. The intervention continued during much of this time with some adaptation, but many other things were happening at the same time. We find that the intervention continued to affect parent behavior during this period, but it is possible that the various changes induced by the pandemic are responsible

for the reduced effect of nurturing care on child development we estimate at age 4.

These findings have two important policy implications. First, our results offer some insights on the fade-out observed in many (but not all: Doyle (2020); Justino et al. (2023)) early child development programs. The fade-out we observe occurred while the intervention was ongoing. Our finding that fade out was due to a change in the causal effect of nurturing care on child outcomes, rather than a diminished impact of the intervention on parents, suggests that different strategies are required to scaffold learning gains as children grow.

Our results for older children suggest that successfully extending the nurturing care framework to support the transition to school may not simply be a matter of applying 'more of the same'. While addressing the care needs of children in this age group remains an urgent priority – McCoy et al. (2022)'s estimate that barely 25% of children aged 3-4 in low-and-middle income countries are receiving minimally adequate nurturing care highlights the magnitude of the challenge – our results suggest that the needs of children in this age group can be quite heterogeneous. Our finding that some children still benefit greatly from the same nurturing care that supported them in younger years is as important as its counterpart: the finding that some children are not benefiting, and may even be experiencing unexpected setbacks.

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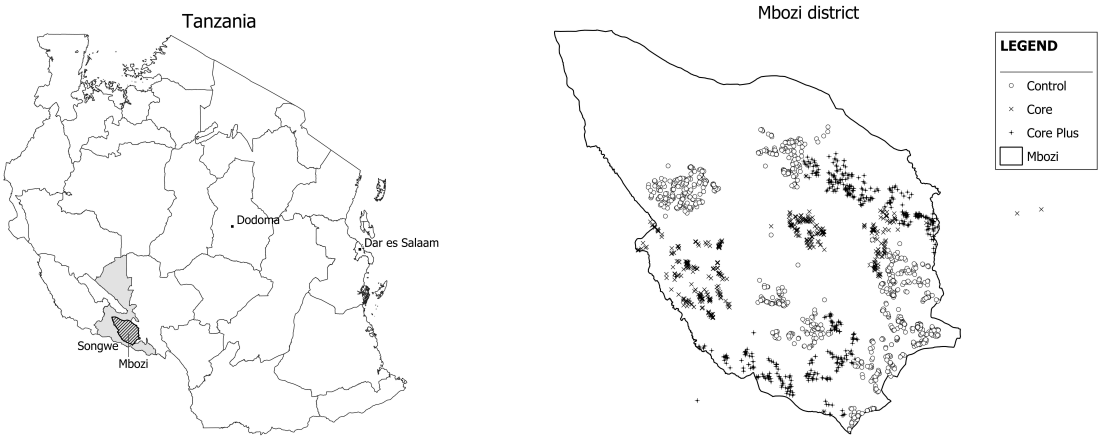
A Further descriptive statistics

A.1 Child development measures

Figure 2: **Study area with Treatment and Control locations**



Maps plotting the study area in the context of Tanzania (L), and Treatment and Control locations within Mbozi district (R). Although Treatment and Control areas were assigned based on ward boundaries at the project inception in 2017, ward boundaries are reviewed annually. Rather than showing ward boundaries, Treatment and Control areas are represented by through GPS data from the baseline survey. These data are somewhat noisy: some points appear incorrectly outside the study area. Map credit: Himangshu Kumar; base maps from https://data.humdata.org. These maps previously appeared in Leighton et al. (2023).

Table 7: **CREDI & IDELA validation: correlations**

Variables	ECD age 0	ECD age 2	ECD age 4
ECD age 0	1.000		
ECD age 2	0.154	1.000	
ECD age 4	0.076	0.135	1.000

Notes: pairwise correlations. Sample includes control group only.

B Extended results

Figure 3: **Distribution of normalized development scores**

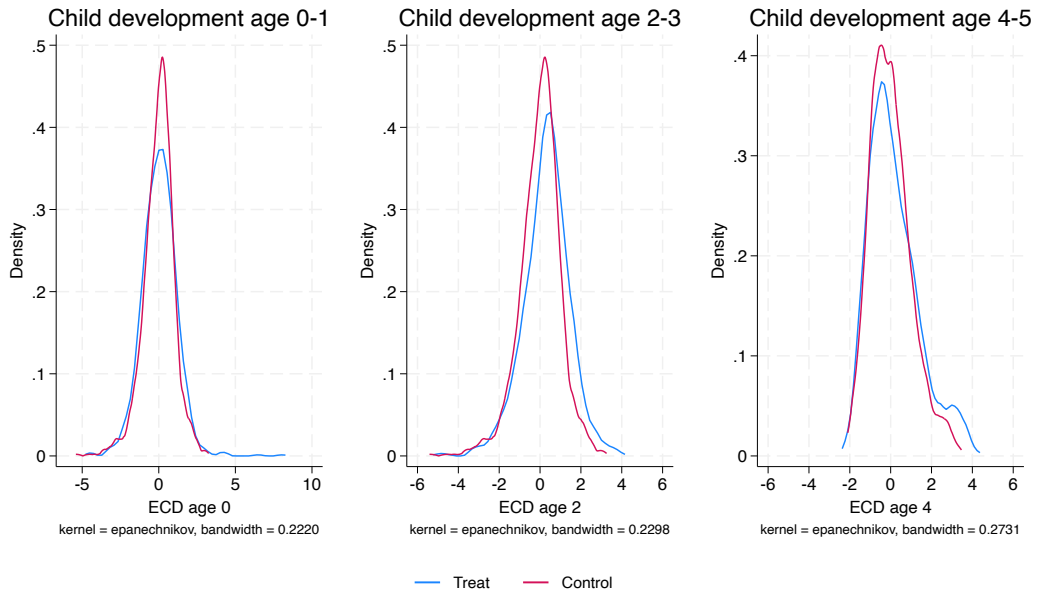


Table 8: **CREDI & IDELA validation: regressions**

	(1) ECD age 0	(2) ECD age 2	(3) ECD age 4	(4) ECD age 2	(5) ECD age 4	(6) ECD age 4	(7) ECD age 4
ECD age 0				0.173***	0.0868**		0.0582
				(0.0345)	(0.0349)		(0.0379)
ECD age 2						0.121***	0.112***
						(0.0382)	(0.0386)
Girl child	-0.102*	0.0157	0.154**	0.0362	0.162**	0.153**	0.159**
	(0.0583)	(0.0686)	(0.0686)	(0.0677)	(0.0684)	(0.0739)	(0.0740)
Age in months	-0.0545***	0.0191	0.0429***	0.0279**	0.0472***	0.0407***	0.0438***
	(0.0117)	(0.0136)	(0.0137)	(0.0135)	(0.0138)	(0.0146)	(0.0147)
SES (in sd)	0.103***	0.0925**	0.0646*	0.0765**	0.0565	0.0386	0.0342
	(0.0302)	(0.0365)	(0.0365)	(0.0362)	(0.0366)	(0.0400)	(0.0401)
Mother literate	0.0707	0.197**	0.294***	0.196**	0.289***	0.268***	0.270***
	(0.0812)	(0.0955)	(0.0946)	(0.0942)	(0.0943)	(0.103)	(0.103)
Father literate	0.339***	0.0799	0.262**	0.0146	0.228*	0.350***	0.327**
	(0.109)	(0.125)	(0.124)	(0.124)	(0.124)	(0.132)	(0.133)
Constant	0.0992	-0.388**	-0.885***	-0.404**	-0.885***	-0.914***	-0.922***
	(0.151)	(0.175)	(0.177)	(0.173)	(0.176)	(0.190)	(0.190)
Observations	1134	846	823	846	823	710	710

Notes: sample includes control group only. Estimates from OLS regression with child development score as the outcome. All regressors are shown. Standard errors (not clustered) in parentheses, * $p < 0.10$ ** $p < 0.05$, *** $p < 0.01$.

Table 9: **IV estimates: age 2 domains**

	(1) ECD age 2	(2) Motor age 2	(3) Cognitive age 2	(4) Language age 2	(5) SEM age 2
Nurture age 2	0.569***	0.429**	0.517***	0.577***	0.465***
	(0.159)	(0.178)	(0.161)	(0.154)	(0.163)
ECD baseline	0.130***				
	(0.0366)				
Nurture age 0	0.0389*	0.0413*	0.0483**	0.0314*	0.0434*
	(0.0211)	(0.0239)	(0.0235)	(0.0166)	(0.0260)
Motor age 0		0.121***			
		(0.0327)			
Cognitive age 0			0.114***		
			(0.0343)		
Language age 0				0.0696*	
				(0.0364)	
SEM age 0					0.122***
					(0.0314)
Observations	1505	1505	1505	1505	1505

Notes: all baseline controls are included (not shown). Standard errors (clustered at the Ward level) in parentheses, * $p < 0.10$ ** $p < 0.05$, *** $p < 0.01$.

Table 10: **IV estimates: age 4 domains**

	(1) ECD age 4	(2) Motor age 4	(3) Literacy age 4	(4) Numeracy age 4	(5) SED age 4
Nurture age 4	0.219	0.144	0.420**	0.137	0.0829
	(0.219)	(0.191)	(0.201)	(0.229)	(0.190)
ECD age 0	0.0595*	0.0453**	0.0318	0.0427	0.0711**
	(0.0326)	(0.0210)	(0.0330)	(0.0393)	(0.0283)
Nurture age 0	0.0272	0.0105	0.0158	0.0285	0.0329
	(0.0220)	(0.0247)	(0.0217)	(0.0246)	(0.0323)
Observations	1360	1360	1360	1360	1360

Notes: all baseline controls are included (not shown). SED = socioemotional development. Note that the lagged value of these domains is not included, as there is no clear match between most of these domains and the CREDI domains from the previous waves. Standard errors (clustered at the Ward level) in parentheses, * $p < 0.10$ ** $p < 0.05$, *** $p < 0.01$.

Table 11: **Effect of nurturing care on child development: by different remoteness variables**

	Age 2				Age 4			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dist road high x treat	0.577				0.151			
	(0.241)				(0.294)			
Dist road low x treat	0.628				0.387			
	(0.213)				(0.34)			
Dist highway high x treat		0.721				0.193		
		(0.162)				(0.12)		
Dist highway low x treat		0.358				0.218		
		(0.147)				(0.487)		
Dist town high x treat			0.807				0.515	
			(0.278)				(0.251)	
Dist town low x treat			0.469				-0.064	
			(0.114)				(0.318)	
Remote = 1 x treat				0.701				0.458
				(0.146)				(0.205)
Remote = 0 x treat				0.401				0.013
				(0.225)				(0.553)
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Chi2	0.022	2.924	1.55	1.711	0.234	0.002	2.532	0.514
Chi2 p-val	0.883	0.087	0.213	0.191	0.628	0.963	0.112	0.474
N	1505	1505	1505	1247	1360	1360	1360	1360

Notes: each column presents the coefficients of interest from an estimation of Equation 4 fully interacted with a different binary heterogeneity variable. All baseline control variables (not shown) are included. The Chi2 statistics is for a test of equality of the interacted treatment effects. Standard errors (clustered at the ward level) shown in parenthesis.

Table 12: **Mediation analysis: age 2-3**

	Indirect effect: mediator on outcome	Bias-corrected CI: lower	Bias-corrected CI: upper	Fraction of total effect mediated by individual mediators	Sig at 95%
Mother interaction	0.012 (0.0101)	-0.005	0.036	0.047	
Father interaction	0.042 (0.0139)	0.017	0.074	0.17	Y
Mother positive parenting	0.027 (0.0104)	0.009	0.049	0.11	Y
Mother negative discipline	0 (0.0162)	-0.029	0.033	0	
Father positive parenting	0.007 (0.0061)	-0.003	0.023	0.028	
Father negative discipline	-0.002 (0.0098)	-0.023	0.015	-0.007	
Diversity of toys	0.058 (0.0148)	0.03	0.09	0.235	Y
	Effects: summary				
Total indirect effect	0.143 (0.0279)	0.088	0.201		Y
Total direct effect	0.102 (0.0606)	-0.009	0.219		
Total effect	0.245 (0.0616)	0.126	0.355		Y
% of total effect mediated				0.583	

Table 13: **Mediation analysis: age 4-5**

	Indirect effect: mediator on outcome	Bias-corrected CI: lower	Bias-corrected CI: upper	Fraction of total effect mediated by individual mediators	Sig at 95%
Mother interaction	0.093 (0.0272)	0.047	0.146	0.965	Y
Father interaction	-0.021 (0.012)	-0.047	0.001	-0.213	
Mother positive parenting	-0.007 (0.0062)	-0.024	0.001	-0.076	
Mother negative discipline	-0.042 (0.0163)	-0.08	-0.015	-0.429	Y
Father positive parenting	-0.005 (0.0063)	-0.02	0.005	-0.05	
Father negative discipline	0.024 (0.0117)	0.005	0.051	0.249	Y
Diversity of toys	0.036 (0.0131)	0.012	0.062	0.369	Y
	Effects: summary				
Total indirect effect	0.079 (0.0339)	0.009	0.142		Y
Total direct effect	0.018 (0.07)	-0.12	0.153		
Total effect	0.097 (0.075)	-0.047	0.239		
% of total effect mediated				0.815	

Table 14: **Pre-primary attendance**

Variable	**Mean**	**Std. Dev.**	**N**
Treat			
Attends PP	0.191	0.394	758
Attends PP regularly	0.132	0.339	755
Attends PP regularly x age 5	0.014	0.116	735
PP start age	3.95	0.59	141
Control			
Attends PP	0.117	0.322	804
Attends PP regularly	0.101	0.301	804
Attends PP regularly x age 5	0.001	0.035	800
PP start age	3.857	0.382	91

Table 15: **Predicting pre-primary attendance**

	(1) Attends PP	(2) Attends PP	(3) Attends PP regularly	(4) Attends PP regularly
ECD age 0	0.0322***	0.0253**	0.0253**	0.0160
	(0.0115)	(0.0128)	(0.0107)	(0.0120)
Nurture age 0	0.0152	0.0119	0.0130	0.00905
	(0.0113)	(0.0127)	(0.0106)	(0.0119)
First child	0.0101	0.0176	0.0123	0.0107
	(0.0295)	(0.0343)	(0.0275)	(0.0321)
Female respondent	-0.0141	-0.0315	-0.0115	-0.0216
	(0.0430)	(0.0471)	(0.0401)	(0.0440)
Girl child	-0.0107	-0.0201	-0.0175	-0.0277
	(0.0224)	(0.0248)	(0.0209)	(0.0232)
Age in months	0.0183***	0.0140***	0.0165***	0.0136***
	(0.00451)	(0.00488)	(0.00421)	(0.00455)
SES (in sd)	0.0271**	0.0165	0.0401***	0.0353***
	(0.0127)	(0.0141)	(0.0118)	(0.0132)
Young mother	0.00552	0.0202	-0.00178	0.0209
	(0.0270)	(0.0302)	(0.0252)	(0.0282)
Mother literate	0.0225	0.0172	0.0171	-0.00539
	(0.0312)	(0.0348)	(0.0291)	(0.0325)
Father literate	0.00864	0.00430	-0.00935	-0.00805
	(0.0412)	(0.0447)	(0.0384)	(0.0418)
Remoteness	-0.0260***	-0.0190*	-0.0230***	-0.0137
	(0.00868)	(0.00996)	(0.00810)	(0.00930)
ECD age 2		0.0304**		0.0280**
		(0.0140)		(0.0131)
ECD age 4		0.0408***		0.0446***
		(0.0136)		(0.0127)
Nurture age 2		0.00946		0.00615
		(0.0136)		(0.0127)
Nurture age 4		0.00919		0.00518
		(0.0134)		(0.0126)
Constant	-0.0179	0.0224	0.00376	0.0346
	(0.0704)	(0.0765)	(0.0656)	(0.0714)
Observations	799	613	799	613

Notes: sample includes control group only. Estimates from OLS regression with binary attendance variable as the outcome. Standard errors (not clustered) in parentheses, * $p < 0.10$ ** $p < 0.05$, *** $p < 0.01$.

Table 16: **Age 4 development scores: pre-primary robustness check**

	(1)	(2)	(3)	(4)	(5)
	ECD age 4	ECD age 4	ECD age 4	ECD age 4	ECD age 4
Nurture age 4	0.219	0.179	0.0585	0.361*	0.326
	(0.219)	(0.213)	(0.190)	(0.207)	(0.200)
ECD age 0	0.0595*	0.0596*	-0.0947	0.0416	0.0554**
	(0.0326)	(0.0305)	(0.0727)	(0.0307)	(0.0276)
Nurture age 0	0.0272	0.0257	-0.0563	0.00557	-0.00625
	(0.0220)	(0.0233)	(0.0385)	(0.0196)	(0.0256)
First child	-0.199**	-0.211**	-0.283***	-0.199**	-0.207**
	(0.0861)	(0.0842)	(0.0925)	(0.0936)	(0.100)
Female respondent	0.145	0.139	0.221*	0.137	0.156
	(0.134)	(0.138)	(0.129)	(0.146)	(0.133)
Girl child	0.152***	0.142***	0.262***	0.0955*	0.127**
	(0.0516)	(0.0509)	(0.0623)	(0.0575)	(0.0536)
Age in months	0.0180	0.0113	-0.0922*	0.0128	0.0166*
	(0.0122)	(0.0132)	(0.0474)	(0.0126)	(0.00980)
SES (in sd)	0.0257	0.0179	-0.226**	-0.00217	0.0101
	(0.0370)	(0.0345)	(0.109)	(0.0334)	(0.0334)
Young mother	-0.0583	-0.0508	-0.0368	-0.0647	-0.0424
	(0.0552)	(0.0588)	(0.0587)	(0.0567)	(0.0661)
Mother literate	0.142*	0.135*	0.0766	0.0606	0.0991
	(0.0822)	(0.0769)	(0.104)	(0.0821)	(0.0794)
Father literate	0.0978	0.0952	0.199**	0.0578	0.0279
	(0.0928)	(0.0864)	(0.0978)	(0.0798)	(0.0945)
Dist to highway	-0.00508	-0.00543	0.00281	-0.00281	-0.00335
	(0.00674)	(0.00659)	(0.00654)	(0.00712)	(0.00782)
Dist to any road	-0.0610***	-0.0592***	-0.0342*	-0.0528**	-0.0526**
	(0.0213)	(0.0206)	(0.0204)	(0.0228)	(0.0235)
Dist to nearest town	-0.00226	-0.00136	0.00989	-0.00298	-0.00214
	(0.00850)	(0.00809)	(0.0108)	(0.00793)	(0.00936)
Attends PP regularly		0.328**			
		(0.157)			
Predicted PP			6.717***		
			(2.597)		
Constant	-0.215	-0.196	-0.719***	-0.126	-0.181
	(0.201)	(0.206)	(0.201)	(0.211)	(0.193)
Observations	1360	1347	1360	1198	1165

Notes: each column presents results from a 2SLS estimation of Equation 4. Column (1) replicated our main results for ease of comparison. Column (2) controls for pre-primary attendance, Column (3) controls for predicted pre-primary attendance; Column (4) drops all children attending pre-primary, Column (5) drops all children with a 20% or higher predicted likelihood of attending primary. Standard errors (not clustered) in parentheses, * $p < 0.10$ ** $p < 0.05$, *** $p < 0.01$.

C Overview of curriculum materials

Tuwekeze Pamoja
Curriculum for Caregivers with Children 0-3

Session Objectives:

1. **MY DREAM FOR MY CHILD'S FUTURE**
    a. Set a positive and welcoming environment for the parenting sessions
    b. Describe the type of young person you want your baby to grow up to be
    c. Discuss how a parenting style can help or stop your child from becoming the person you want them to be
2. **MY RELATIONSHIP WITH MY CHILD**
    a. Use every day strategies (such as holding, talking and singing) to form strong bonds with infants and toddlers.
    b. See how bonding with infants and toddlers helps the brain to grow.
    c. Use strategies to keep child calm through comforting and soothing
3. **PLAY FOR GROWTH**
    a. Recognise the links between active play and development
    b. Use a range of strategies in the home to support active play and development
4. **PLAY TO LEARN**
    a. Explain how different play activities can support learning in different areas (domains).
    b. Use objects, games and toys found in the home to help children to learn about concepts like size, shape, colour, counting and matching.
5. **WAYS TO COMMUNICATE WITH YOUR YOUNG CHILD**
    a. Recognise different ways that babies and young children communicate even without using words
    b. See that children understand much more language than they can say
    c. Practice ways to help early language skills develop
6. **FEEDING WITH CARE**
    a. Understand that feeding time is a great opportunity for responding and nurturing.
    b. Learn why proper breastfeeding and good nutrition is important for optimal growth and development.
    c. Learn how to plan balanced meals for children in the first 3 years.
7. **PARENTING WITHOUT VIOLENCE**
8. **ROUTINES AND INDEPENDENCE**
9. **HELPING YOUR CHILD TO TALK AND WRITE**
    a. Explain learning starts before birth
    b. Use strategies with their child to help literacy develop every day; through talking, singing and reading.
    c. To make and use books and print materials to support their child's early reading.
10. **READING AND TELLING STORIES**
    a. Explain learning starts before birth
    b. Use strategies with their child to help literacy develop every day; through talking, singing and reading.
    c. To make and use books and print materials to support their child's early reading.

Tuwekeze Pamoja
Curriculum for Caregivers with Children 4-6

Session Objectives:

SESSION 1 – THE BEST FOR MY CHILD
- Caregivers understand the unique value and potential of each individual child.
- Caregivers are able to listen to each child's opinions and engage them in decision making in the home.

SESSION 2 – RIGHT FOOD FOR MY CHILD
- Caregivers Identify and use age appropriate ways of feeding children with sufficient and balanced diet
- Caregivers practice developing a well balanced meal for their children aged 4-6

SESSION 3 –PARENTING WITHOUT VIOLENCE
- Caregivers identify and use Parenting without violence approaches that are age appropriate
- Caregivers understand the importance of listening to children's opinions and empower them to be independent

SESSION 4 – ROUTINES AND MY CHILD'S GROWING INDEPENDENCE
- Caregivers identify and use different routines which help to manage each individual child's behaviour and growing independence.
- Caregivers provide praise and encouragement to their child/children when they have done something well

SESSION 5 – MAKING TOYS WITH LOCAL RESOURCES
- Caregivers are able to engage children to identify and make use of different locally available play materials that are safe and age appropriate for child development
- Caregivers explore and challenge existing gender norms that relate to children play materials
- Caregivers recognise and address gender differences in play and how to support children

SESSION 6 – THE ROAD TO READING
- Caregivers know the value of children reading and telling stories
- Caregivers regularly listen to, read and tell stories to their young child

SESSION 7 – COUNTING. MEASURING, COMPARISON, PATTERNS, ORDERING
- Caregivers understand different ways to support their child's pre-numeracy development.
- Caregivers are able to use different ways/strategies to support their child's pre-numeracy development.

SESSION 8 – SCHOOL READINESS
- Caregivers understand the importance of supporting their child's learning at (pre)primary school and building a positive relationship with their child's teacher.
- Caregivers are able to support their child's learning at (pre)primary school and build a positive relationship with their child's teacher.

Tuwekeze Pamoja
Core Plus Curriculum

Session Objectives:

- **Who Cares for Children**
  - Identify who is important in the lives of your children and who can support you?
  - Identify the type of father or mother you want to be for your children's future.
- **Managing Stress**
  - Recognise how stress can harm yourself, your relationships, and your children
  - Identify healthy ways of dealing with stress.
- **Resolving Conflict in the Home**
  - Practice respectful non-violent communication and problem solving at home
- **Gender and Parenting**
  - Decide the type of father or mother you want to be for your children's future.
  - Men play an important role in supporting their wives and helping their children develop.
- **Commitments**
  - Make a commitment to reducing violence at home and in the community