Maternal Depression, Parenting Behaviors and Child Development: Evidence from a Randomized Control Trial

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Victoria Baranov [*] Sonia Bhalotra [†] Joanna Maselko [‡]

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Abstract

We evaluate the impacts of maternal depression on children's skill accumulation, exploiting randomized variation in depression created by a cluster-randomized control trial that provided cognitive behavioral therapy to women in rural Pakistan who were diagnosed as depressed in pregnancy. We conducted a followup study when the children were age 7 and assessed their cognitive, socio-emotional and physical development, parental investments in children, indicators of the quality of parenting, and of the home environment. The intervention was successful in reducing maternal depression and this effect was sustained. We also find that treated mothers exhibit better parenting behaviors, provide a better home environment and invest more in their children's education. We nevertheless find, on average, no detectible effects on children's cognitive, socio-emotional or physical development at age 7. We show that this is not because of differential attrition, differential shocks to treated vs control clusters or low power. With the odd exception, we find no evidence that the average results conceal large effects in relevant sub-samples, or in a segment of the distribution of outcomes. Since we find reinforcing parental investments in many domains in the treated group, it is also unlikely that the results are explained by unobserved compensating investments in the control group. We conclude that there are possibly positive but latent effects of the intervention that may be detectible in later life.

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[*]University of Melbourne. *Email: victoria.baranov@unimelb.edu.au*

[†]University of Essex. *Email: srbhal@essex.ac.uk*

[‡]Duke University. *Email: joanna.maselko@duke.edu*

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Keywords: early life, child development, mental health, depression, randomized controlled trial

1 Introduction

How does maternal depression impact the health and development of the child? Depression around the time of childbirth is common in both developed and developing countries. Perinatal depression affects 10-15% of mothers worldwide, leaving 10-35% of children exposed to maternal depression in their first year of life (Rahman, 2005). Poor mental health, or psychological well-being, may be an important and yet understudied factor in the persistence of poverty (Banerjee and Duflo, 2007; Case and Deaton, 2005; Haushofer and Fehr, 2013).[1] With good mental health, individuals can tolerate reasonable amounts of pressure, adapt to changing circumstances, and work according to their abilities (WHO, 2005). Despite its potential importance in the intergenerational transmission of socioeconomic inequality, little is known about how maternal depression impacts child development.

Conditions in the womb and in early life may have large implications for later life outcomes. For example, studies have found that shocks to the physical health of pregnant women have large and long-lasting effects on outcomes of the children (Almond and Currie, 2011b,a; Currie, 2011). Early childhood environment is also important in explaining later outcomes as adults. Gaps in cognitive function and personality traits that emerge very early in life persist, and grow, over time through dynamic complementarity (Cunha et al., 2010; Conti and Heckman, 2014). For example, Perry Preschool and Abecedarian projects in the U.S. show large positive effects of early environment enrichments for disadvantaged children on behavioral traits, school achievements, and job performance. Other studies have found that early home environment and stimulation can impact both cognitive and non-cognitive skills (Walker et al., 2005; Carneiro et al., 2007; Attanasio et al., 2014).

Maternal depression around the time of childbirth has been adversely associated with psychological development, intellectual competence, and psychosocial function throughout childhood and even into adulthood (Murray et al., 1996, 1999). Prenatal depression is likely to have physiological effects and is associated with adverse perinatal outcomes such as slower fetal growth rates. In addition to in-utero effects of perinatal depression, postpartum depression may also play a roll in child outcomes. Adverse effects of postnatal depression on infant development are mediated through the child's direct exposure to mother's depressive symptoms and difficulties of parenting associated with depression (Murray and Cooper, 1997). Mothers provide infants with essential care, from breastfeeding to engaging with the child. Mothers suffering

[1] A fairly large literature in public health hypothesizes that mental health may play a role in generating poverty traps (Knapp et al., 2006; Lund et al., 2011; Patel and Kleinman, 2003).

from depression may not eat nutritiously, thereby affecting the quality of breastmilk, they may stop breastfeeding earlier, and they may not play with the child or provide a stimulating environment. Furthermore, they may neglect to go for immunizations or do other tasks to ensure adequate care is given to the child.

Economic theory predicts that maternal depression may also impact the human capital development of the child through optimal parental investments. Due to adverse physiological effects, perinatal depression is a negative shock to the human capital endowment of the infant. Parents may exhibit reinforcing behavior, investing less in infants exposed to maternal depression, because of static complementarity (Becker and Tomes, 1986). Alternatively, parents may exhibit compensating behavior, investing more in exposed children, if they are inequality averse. Furthermore, maternal depression may impact the mothers' cost of effort, time preferences, and/or aspirations, which would generally reduce maternal investment. In this case, there may be compensatory behavior within the family, where husbands and extended family members help with child-rearing.

Given the strong associations between maternal depression and child outcomes and the importance of early life conditions on later life outcomes, providing adequate care for mental illness could be an extremely important and cost effective method to improving early life conditions. Furthermore, since maternal depression is more likely and more severe among mothers with limited financial resources, providing care during the critical period around childbirth could dramatically affect the intergenerational transmission of inequality. However, little is known about the causal effect of maternal mental health on child outcomes. While studies find that children born to mothers who were perinatally depressed appear to have worse outcomes in childhood and later into adult life, it is not easy to rule out the confounding effects such as employment or health shocks.

This paper aims to bridge the gap by evaluating the medium-term impacts of a large randomized controlled trial for perinatally depressed mothers on child development. The intervention, called Thinking Healthy Programme (THP), used cognitive behavioral therapy techniques of active listening, collaboration with the family, guided discovery to treat perinatal depression of pregnant mothers. Village based community health workers were trained to provide this enhanced care with routine practice of maternal and child health education. Both treatment and control arms received 16 home visits: 4 in the last month of pregnancy, 3 neonatal, and the rest monthly. All mothers were then re-interviewed 6 months and 12 months postnatally to assess the effectiveness of the intervention on maternal depression. Mother and child dyads were re-interviewed in 2013, 7 years after the start of the intervention, and we use this

follow-up survey to assess whether the treatment had an impact on the development outcomes of the children.[2]

The trial had first order effects on the mother's depression status and behaviors such as breastfeeding and interacting with the infant (Rahman et al., 2008). Treated mothers in our sample were 30 percentage points less likely to be depressed a year after their child's birth and the intervention was effective in reducing the presence and severity of depression. Rahman et al. (2008) find that infants of treated mothers in this study were more likely to have completed immunization and were less likely to experience episodes of diarrhea during a 12 month follow-up survey. Mothers and fathers in the intervention group were more likely to spend time playing with their children, and mothers in the treatment group were more likely to exclusively breastfeed the child. The effects of the trial on maternal depression are evident even at the 7 year followup, particularly for mothers who had limited social support at baseline. At the 7 year followup, mothers were 6 percentage points less likely to be depressed as a result of treatment.

Surprisingly, we find generally no effects on a broad range of child outcomes by age seven. For example, child of treated mothers were of similar stature at age 7 as child of control mothers. They also had similar test scores in Math and Urdu and performed similarly on the Wechsler Preschool and Primary Scale of Intelligence. Furthermore, comparing control children to children of mothers who were not prenatally depressed revealed very limited differences in outcomes for physical growth and cognitive function; however, children of prenatally non-depressed mothers exhibited somewhat better socio-emotional outcomes. We are able to rule out a positive effect of the intervention on the socio-emotional domain of 0.05 standard deviations. Are null results cannot be explained by attrition or spurious trends in the intervention clusters.

Finally, our null results on child development cannot be explained by compensating investment in the control group as we find systematic evidence that home environment and parental investment were positively affected by treatment. Parenting quality improved in the short-run (when the infant was 12 months) and effects were detectible at the 7-year followup. We see improvements on the order of 0.2 standard deviations in three domains of parenting: time-intensive and monetary-intensive investments, and parenting style. These results are robust to corrections for attrition and multiple hypothesis testing. Thus, our findings are consistent with the model of static complementarity and reinforcing investment. While there is limited evidence that the

[2]Previous studies find that measures of human capital at ages 6-8 can explain a substantial amount variation in educational attainment (McLeod and Kaiser, 2004) and wages in adulthood (Currie and Thomas, 2012).

intervention impacted child development by age 7, the parental investment patterns suggest that future followups may uncover latent or delayed effects. Our null findings on child development, while positive impacts on parenting behavior echo those of a recent paper evaluating the Triple P parenting program for low income families in Ireland (Doyle et al., 2013).

Our study is amongst a few that explore the causal impact of improving mental health, by providing psychotherapy, on outcomes. A notable example is Heller et al. (2013), which reports the results of a large randomized field experiment with high-crime youth in Chicago, finding that in-school programming incorporating cognitive behavioral therapy (CBT) reduced violent-crime arrests and generated sustained gains in schooling outcomes. Our intervention was similar in intensity, in terms of duration, number of sessions, and contact hours, to that of Heller et al. (2013). While these recent studies providing CBT for subgroups of the population with particular behavioral problems appears to be effective at modifying behavior (Heller et al., 2013, 2015; Blattman et al., 2015), it is unclear whether improved mental health more broadly could impact economic decision-making.

Our study also adds to a growing literature that has explored the impacts of maternal stress or other traumatic shocks around the time of childbirth on later life outcomes. Persson and Rossin-Slater (2014), for example, find that perinatal stress caused by the death of close relative strongly impacts later life outcomes for children in utero. Aizer et al. (2009) find that maternal stress, measured using cortisol levels, is associated with worse cognitive function. On the other hand, Black et al. (2014) find that maternal stress caused by the death of a relative does not impact later life outcomes. These studies, which are based on non-experimental variation, provide conflicting evidence on the role of maternal mental well-being on later life outcomes for children. Thus, identifying the true effect with observational data might be a challenge due to unobserved time-varying factors that could generate misleading findings. Due to the experimental setup, our study provides more concrete evidence on role of maternal mental health on child outcomes.

The rest of the paper is organized as follows. Section 2 provides an overview of the related literature (Appendix Section A surveys the psychology literature and elaborates on the physiological and behavioral mechansims by which maternal mental health may impact child development), and Section 3 describes the intervention. In Section 4, we describe our empirical strategy and address potential threats to the validity of the experiment. Section 5 presents the overall results of the program both in the short-run and the long-run. Finally, Section 6 discusses the potential explanations for our findings.

2 Related Literature

Defined broadly, mental health goes beyond the absence of a mental disorder to include concepts such as subjective well-being, perceived self-efficacy, autonomy, competence, and the achievement of one's intellectual and emotional potential. Layard et al. (2014) find that the most powerful childhood predictor of adult life-satisfaction is the child's emotional health. Mental health is closely related to non-cognitive skills (or psychosocial competencies) and is considered an important input into the human capital production function (Heckman et al., 2006; Currie and Stabile, 2006; Currie, 2009; Krishnan and Krutikova, 2013). The productive potential of mental health, combined with the recent findings suggesting the poverty itself may have direct effects on mental health by increasing exposure to long-term stress (Haushofer and Shapiro, 2013; Haushofer and Fehr, 2014), imply that mental health may be an important mechanism reinforcing the persistence of poverty.

Mental health may be important for decision-making by affecting aspirations. Poverty traps may arise due to internal constraints reflecting low aspirations or reference points (Dalton et al., 2010; Genicot and Ray, 2009; Ray, 2006). Aspirations are closely related to psychological concepts of locus of control and fatalism, which are themselves components of mental health. Empirical studies have found that the role of aspirations in economic decision-making may be quantitatively large (Macours and Vakis, 2009; Bernard et al., 2011; Glewwe et al., 2015). Poverty may increase the risk of maternal depression, which could affect the aspirations and effort of the mother.

Psychological processes may contribute to the persistence of poverty through yet another channel called scarcity. In the scarcity hypothesis, the presence of a scarce resource may alter cognitive function by creating tunneling, or excess focus and attention, on the scarce resource at the expense of attention to other dimensions (Shah et al., 2012; Mani et al., 2013; Mullainathan and Shafir, 2013). The alterations on cognitive function are predictable: individuals become more present-biased, and executive function with respect to tasks that are not immediately related to the scarce resource becomes hindered. Psychological well-being, or mental health, might reflect the individual's ability to control or mitigate the psychological effects of scarcity. Thus, mental health may play an even more important role for individual decision-making in resource-poor conditions.

Our study also contributes to the vast literature on early childhood environment and later life outcomes. Studies exploring the determinants of mental health suggest that early life conditions may also affect later life mental health outcomes (Persson and Rossin-Slater, 2014; Adhvaryu et al., 2014; Friedman and Thomas, 2009; Kesternich

et al., 2013). Adult mental health problems impair productivity and potentially hamper economic decision-making (Kessler and Frank, 1997; Currie and Madrian, 1999; Organization, 2003). Since poverty places mothers at higher risk for more severe and untreated perinatal depression, which in turn affects the quality of parenting during critical periods of child development, maternal depression would appear to be an intergenerational pathway generating a poverty trap. However, there are also important behavioral responses to early life shocks that might exacerbate or diminish the long-term repercussions of the shocks (Adhvaryu et al., 2015; Kesternich et al., 2013). While a number of studies explore the relationship between mental health and life outcomes, relatively little is known about the causal link between mental health and decision-making.

Recent studies have explored the effects of early life shocks on later outcomes, and focused in particular on simple health interventions that can mitigate the effects of in utero shocks. For example, Gunnsteinsson et al. (2014) find that vitamin A delivered to infants at birth largely protected them from the deleterious effects of a severe tornado which was experienced in utero. Attanasio et al. (2014), in a large randomized intervention in Colombia, explored the effects of micronutrient supplementation and psychosocial stimulation for children aged 1-2 years. They find that the psychosocial stimulation improved cognitive scores, while micronutrient supplementation had no significant effect on any outcome. Investigating these results further, Attanasio et al. (2015) find that the improvements in cognitive score were largely driven by increases in endogenous parental investments.

Finally, a large literature has investigated how child care and maternal leave policies impact later child outcomes. Overall, studies have found little evidence that mothers' return to work behavior after childbirth negatively impacts child outcomes (Washbrook et al., 2011; Dustmann and Schönberg, 2012). A notable exception is Baker et al. (2008), who find that the expansion of highly subsidized childcare in Canada had negative effects on child outcomes, such as aggressive behavior, motor skills, and illness, at age 2. The authors also find that the policy increased parental anxiety. However, analyzing the same policy when the children were aged 4 and 5, Baker and Milligan (2015) find no lasting negative effects on child cognitive or socio-emotional development. These results remain somewhat puzzling, since maternal employment generally replaces breastfeeding and reduces maternal time spend with the child. On the other hand, maternal employment increases household income. Furthermore, working mothers may trade quantity of time for better "quality" of time (Hsin and Felfe, 2014).

3 The Intervention: Thinking Healthy Programme

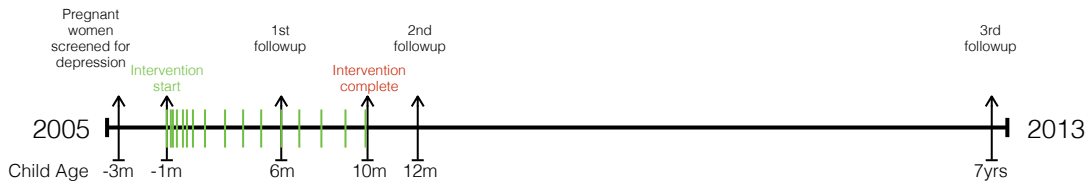
The Thinking Healthy Programme (THP) was a cluster randomized community trial of a perinatal depression intervention in rural Punjab province, Pakistan. 20 Union Council administrative units, the smallest geo-political unit, were randomized to intervention and 20 clusters into the control arm. The study enrolled women in these 40 Union Councils from April 2005 to March 2006. All women in their third trimester of pregnancy (married, ages 16-45, no other significant illness) who met Diagnostic and Statistical Manual of Mental Disorders, IV-TR (DSM-IV) diagnostic criteria for Major Depressive Episode, evaluated by psychiatrists, were invited to participate in the study. There were 463 depressed mothers in the clusters randomized to the THP intervention and 440 depressed women who were in the control arm clusters. All women who were offered to participate in the study accepted the invitation.

The intervention was delivered by Lady Health Workers (LHWs) through 16 home visits to each respondent. The intervention consisted of a weekly session for 4 weeks in the last pregnancy month, three sessions in the first postnatal month, and monthly sessions thereafter for the following 9 months. Mothers in the control arm received enhanced routine care with an equal number of visits.

During the Cognitive Behavioral Therapy (CBT) based sessions, the LHW focused on identifying and modifying cognitive distortions common in depression specific to how the mother views her own health, her relationship with the baby, and the people around her (changing "unhealthy thinking" to "healthy thinking"). Mothers received health education and supporting materials with pictorial and verbal key messages to facilitate discovery of alternative health beliefs. The intervention was based on a psychosocial model and not presented as a treatment for a mental health problem.

The THP study conducted detailed followup surveys at 6 months and 12 months post-partum to evaluate maternal mental health, infant outcomes, parenting behavior and other household characteristics. The timeline for the intervention and all followups is summarized in figure 3.1.

Figure 3.1 – Timeline of intervention and followups



There had been no additional data collection, followup, or contact with the women

since 2007 when the children were 12 months old. In 2013, when the children were 7 years old, a followup study was initiated in order to assess the children's developmental outcomes. The interviews at the 7-year followup for each mother and child dyad were conducted in two parts: the first in the mother's home and second was either in the child's school or in the local LHW's house. Cognitive tests were thus administered by the interviewer in a more standardized environment than the home. Further details of the intervention and 7-year followup are provided in Appendix Section **??**.

4 Empirical Analysis

4.1 Data

4.1.1 Sample

463 mothers received the treatment intervention (THP) and 440 mothers were in the control group. After 1 year, 412 treated mothers and 386 mothers in the control group were analyzed. Further, 360 infants in the treated group and 345 infants in the control group were analyzed at 1 year. The 7-year followup study took as a starting sample the mother-child dyads who completed the 1-year followup. The study team successfully located and re-enrolled 83% (n=585) of women and their children who were last interviewed in 2007, with 85.5% (n=296) of the control group dyads and 80.3% (n=289) of the intervention arm dyads.

Our analytical sample comprises of both an experimental group and an non-experimental group. The experimental group consists of 585 mother-child dyads that were located at the 7-year followup. The non-experimental group consists of 300 mother-child dyads which were chosen from among 3242 mothers who had been screened out of the experiment at baseline because they did not pass the DSM-IV criteria for perinatal depression.

Mothers in the experimental group were surveyed at baseline, the 6-month followup, the 1-year followup and the 7-year followup. Mothers that were screened out were not surveyed at baseline or later followups, except for the 300 selected to be part of the non-experimental group followed up at 7 years.

4.1.2 Outcomes

Maternal mental health Maternal depression was assessed by psychiatrists using the Structured Clinical Interview (SCID) for DSM-IV diagnosis. All mothers were evaluated by a psychiatrist at baseline, 6-month followup and 1-year followup to determine if they were experiencing a major depressive episode (MDE). At the 7-year followup, maternal depression was also determined using the SCID interview, but administered directly by assessors. In addition to the binary status of whether the mother was

classified as clinically depressed, the surveys at baseline, 6-month, 1-year, and 7-year followups also contained mental health questionnaires such as the Hamilton Depression Rating, the Generalized Assessment of Functioning, and the Multidimensional Scale of Perceived Social Support.

Child outcomes At 6-month and 1-year followups, interviewers measured the length (height) and weight of the infants. They also asked the mother about the infants' recent diarrheal episodes and Acute Respiratory Infections (ARIs).

At the 7-year followup, the interviewers were able to measure a much broader set out child outcomes along physical, socio-emotional, and cognitive domains. Specifically, cognitive skills were assessed with the Wechsler Preschool and Primary Scale of Intelligence, designed for children between 2.5 and 7.5 years old (WPPSI-IV). WPPSI-IV provides primary index scales for verbal comprehension (VCI), visual spatial (VSI), fluid reasoning (FRI), working memory (WMI), and processing speed (PSI).

Executive functioning was assessed using a Stroop-like Day/Night test, which gauges inhibition and working memory. Additionally, at the start of the interview with the child, basic literacy and numeracy tests were administered, providing math and urdu scores based on the number correct out of 12. The interviewer recorded the grade of the child based on teacher report.

Socio-emotional development was measured along two board domains: behavioral and emotional problems, assessed with the Strengths and Difficulties Questionnaire (SDQ) and anxiety, assessed with the Spence Children's Anxiety Scale (SCAS). Both measures are based on sets of questions answered by the mother.

Physical development was assessed with growth, fine motor skills, and illness. Interviewers measured height and weight and motor skills were assessed using the Grooved Pegboard Test, which asks the child to place pegs in a correct orientation on a board and records the amount of time the child took to complete the task. Further, the mothers reported about any severe illness, hospitalizations, eye and hearing problems of the child.

Home environment and parenting behavior Mothers also answered a detailed module on the home environment, which is a modification of the HOME inventory (Caldwell and Bradley 1984, 1992) similar to the HOME-SF used in a number of studies including the NLSY79. The HOME inventory is based on a set of 54 questions around 8 dimensions: responsivity, encouragement of maturity, emotional climate, learning materials and opportunities, enrichment, family companionship, family integration, and physical environment.

In addition to the HOME inventory, we also have detailed measures of parenting

practices (also a short form version of the Parenting Practices Inventory, or PPI), which captures the disciplinary style of the parents (Webster-Stratton et al., 2001). The short-form PPI is composed of 31 questions assessing the extent of harsh disciplining, inconsistent disciplining, monitoring rated on a 4-point scale ranging from 1 (never) to 4 (always).

The interview included both mother-reported and interviewer-observed measures of school quality. The mother answered some questions regarding education and expectations of the child: notably the type of school the child attends (private/public), expenditures on education, and the expected grade attainment for the child. The interviewer visited the child at school and recorded information about the number of teachers in the school, the number of classrooms, whether the school had amenities such an enclosed playground, computers, etc.

4.2 Econometric Specifications

We first present the treatment effects using the experimental sample. Given that treatment assignment was random, the main identification strategy is straightforward. Our principal estimating equation for impacts on outcome measures is

$$Y_{ic} = \alpha + \beta T_c + \mathbf{\Gamma'} \mathbf{X_{ic}} + \varepsilon_{ic} \tag{4.1}$$

where Y_{ic} is the outcome for the mother-child pair, i, in 2013. T_c is a dummy equal to one if the mother is in the intervention group, which by the cluster design varies only at the Union Council level, c. $\mathbf{X_{ic}}$ is a vector of controls. The baseline specification includes only interviewer fixed effects. We also show the results controlling for a full list of baseline characteristics as well as the interviewer fixed effects. The additional controls are baseline values of mental health measures (Hamilton, BDQ, and MSPSS scores and their squares), as well as baseline demographic characteristics: mother's age, its square, parity, mother's and father's education, a dummy for the presence of a grandmother, a PCA-weighted wealth index, and interview date (in days after the start of data collection). Standard errors are clustered at the Union Council level, the unit of randomization.[3]

The take-up of the treatment was universal, in that all mothers in the treatment groups received the CBT-based psychotherapy. Not all mothers recovered from depression in the treatment arm, and many mothers in the control arm spontaneously recovered. In our analysis, we will focus on producing only the reduced-form results instead of an instrumental variable approach estimating the impact on maternal de-

[3]Child age is excluded from the controls as it is potentially endogenous. The results are similar, however, if we control for age.

pression on child outcomes. We do this because it is possible that the intervention, through encouraging healthy thinking and bonding with the child, may have had direct impacts on child outcomes apart from affecting maternal depression. As such, the exclusion restriction is likely not satisfied.

We will also explore heterogeneity in the treatment effects along several important characteristics. For example, treatment effects may differ by child gender, parental education, wealth, or family structure. We present heterogeneous treatment effects estimating one equation:

$$Y_{ic} = \alpha + \beta_1 Het_i + \beta_2 T_c + \beta_3 Het_i \times T_c + \mathbf{\Gamma'X_{ic}} + \varepsilon_{ic} \tag{4.2}$$

where Het_i is the dimension of heterogeneity we are exploring (all measured at baseline, except for child gender). The coefficient on the interaction term, β_3, allows us to see the differential effect of the intervention along that specified dimension.

We also estimate a second model using the perinatally non-depressed mothers, thus extending the sample to both experimental and non-experimental groups. The estimating equation is

$$Y_{ic} = \alpha + \beta T_c \times Depressed_{ic} + \delta Depressed_{ic} + \eta T_c + \mathbf{\Gamma'\tilde{X}_{ic}} + \varepsilon_{ic} \tag{4.3}$$

where $Depressed_{ic}$ is a dummy that equals one if the mother was deemed perinatally depressed at the baseline screening. The coefficient on the interaction $T_c \times Depressed_{ic}$ will pick up the effect of being in treated group (a Union Council assigned to treatment) and perinatally depressed, controlling for the overall difference between depressed and non-depressed mothers, and the overall effects of being associated with a Union Council assigned to treatment.

The vector of controls in $\mathbf{\Gamma'\tilde{X}_{ic}}$ is different to that in equation 4.1 because we do not have baseline characteristics for perinatally non-depressed mothers. Instead, we include time-invariant demographic characteristics: mother's age and its square, mother's and father's education, parity at baseline (estimated based on parity in 2013 and the reported number of children born since the index child), date of interview and interviewer fixed effects. Standard errors are clustered at the Union Council level for all specifications.

The benefit of this approach is to ensure that our results are not driven spuriously due to some clusters experiencing shocks unrelated to treatment in the period after the 1-year followup. This specification is a difference-in-difference analysis, with one dimension being the randomization. The coefficient β is the parameter of interest

for the treatment effect. The parameter η is of interest as it indicates the average difference between treated and control clusters for mothers who were not part of the experiment.[4] Last, δ provides an estimate of the difference in outcomes between control mothers who were perinatally depressed and mothers who were not perinatally depressed.

4.2.1 Quantile Treatment Effects

We further explore the heterogeneity in impacts of the intervention and by examining the impacts across the distributions of outcomes. We show quantile treatment effects (QTE) for outcomes in child development and parenting behavior, where the QTE is the horizontal distance between the treated and control group CDF at a given percentile. Because treatment was randomized, the treatment effect at the quantiles is also identified. We estimate the QTE for each quantile between 5 and 95.[5] We use inverse propensity score weights to account for observables, controlling for full list of baseline variables described above. For inference, we construct point-wise confidence intervals at each quantile by bootstrapping using 1,000 replications with replacement, clustered at the Union Council level.

4.2.2 Summary Indices

As there are many outcomes, we present results using summary indices following Anderson (2008), by generating indices that are the weighted average of a set of outcomes. The index weights outcomes by the sum of the corresponding row of the inverse covariance matrix of outcomes within the index. As such, this method places more weight on outcomes with more information, e.g. more uncorrelated variation.[6] It is also a Generalized Least Squares estimator, and as such, provides the most efficient estimation of the treatment effect. This approach addresses the problem of multiple inference, but also improves the power of our statistical test for whether the intervention had broad effects.

We group outcomes into three broad domains of child development: cognitive

[4] Alternatively, we could also include Union Council (UC) fixed effects, γ_c, which absorb the indicator for T_c, that is, being assigned to a treatment cluster. Since the parameter η is of interest, we present the results using the more parsimonious specification. However, the results are similar when including UC fixed effects.

[5] We implement the code from Frölich and Melly (2013) to calculate the QTEs. We use a bootstrapping procedure to calculate the confidence intervals instead of the analytical calculations in order to account for the cluster-randomized design.

[6] As an alternative approach, we compute factor scores instead of the summary indices. This method is more suited when the measures included in the factor score are proxies of an underlying latent factor, measured with noise. Compared to the summary index following Anderson (2008), factor scores place less weight on uncorrelated variation. We reestimate the main specifications using factor scores. The results, presented in Appendix Section H, are qualitatively similar.

development, physical development, and socio-emotional development. All variables are standardized relative to the control group, who are set to be mean zero and standard deviation one, and so that positive values are always associated with positive outcomes. Cognitive development includes Full Scale IQ, Urdu and Math scores, Stroop, and grade attainment. Physical development index includes weight-for-age, height-for-age, motor function score, severe illness, hospitalizations, eye and hearing problems. Socio-emotional index includes the Spence anxiety and SDQ behavioral problems scores.

Similarly, we create three indices for parenting outcomes in the domains of parenting style, time-intensive parental investment, and monetary-intensive parental investment. Parenting style includes the PPI score and 4 subscales of the HOME inventory: responsivity, maturity, emotional climate, and integration. The time-intensive investment includes the enrichment and companionship components of the HOME inventory and measure of the frequency of mother and father play with the child and whether someone in family helps the child with their studies. Finally, the monetary investment index includes the learning materials and physical environment subscales of the HOME inventory, education expenditures, expected grade attainment, and school quality. Table E.15 and E.16 show the summary statistics for the variables included in each index for child development and parenting.

4.2.3 Multiple Inference and Power

We further account for multiple hypothesis testing across the three indices within child development and parenting by calculating the family-wise p-value adjustment using a step-down procedure with a non-parametric permutation test (following (Anderson, 2008; Efron and Tibshirani, 1994)). We also use the Family-Wise Error Rate (FWER)-adjusted p-values when we explore the effects of the intervention within the components of the indices.

Power calculations for the 7-year re-enrollment relied on the WPPSI-III full scale IQ measure. Calculations were based on re-enrollment numbers that were slightly optimistic with N of 328 in the THP arm (actual 289) and 314 in the control arm (actual 296) and an inter-cluster correlation (ICC) of 0.05. The ICC was based on the observed ICC in the same clusters for the maternal mental health variables in the original study (Rahman et al., 2008). With these parameters, the study had 80% power to detect 0.36 standard deviation difference in IQ scores. We may also be concerned that the ex-post balance could substantially effect the power of our analysis. Updating the parameters to reflect the actual sample size, and adjusting for the reduction in explanatory variance (by calculating share of variance unexplained after controlling for

the full set of demographics) due to imbalance in covariates, discussed below, the MDE increases to 0.38 standard devisions. Our study is thus powered similarly to the intervention by Attanasio et al. (2014), who provided psychosocial stimulation via weekly home visits to Colombian mothers with children 12-24 months for a period of 18 months. The study was powered to detect a 0.33 standard deviation in test score, and they find that stimulation improved cognitive scores by 0.26 of a standard deviation.

4.3 Sample Balance

Table 1 shows baseline characteristics for the sample of women who were interviewed at the 1-year followup and the 7-year followup sample. There are several notable differences in characteristics between treated and control groups in both samples. Treated women at baseline in the 1-year followup sample are significantly more likely to have a grandmother of the index child (henceforth, just grandmother, which is either the mother's mother, or mother-in-law)[7] living with them, were slightly more educated, and they had a marginally significantly higher wealth index and fewer children. The 7-year followup sample appears similarly balanced, though perceived social support and presence of grandmothers were still greater in the intervention arm, with fewer children. Because balance was weakly achieved from the randomization at the UC level, we present all results with a specification controlling for standard demographic controls any outcomes that were not balanced, notably presence of grandmother (mother or mother-in-law of depressed mother).

4.4 Attrition

The small differences in balance between the 1-year followup sample and the 7-year followup is due to attrition, and at first glance does not appear to be strongly differential by treatment group. Appendix Table D.13 confirms that LTFU (attritors) and mothers that were re-enrolled were fairly similar along many characteristics. LTFU mothers were poorer, perceived less social support, and were less likely to have a grandmother present at the 1-year followup (despite no baseline differences). Appendix Table D.14 shows baseline characteristics of the LTFU women by treatment group. Consistent with the similar balance between the original 1-year followup sample and the 7-year followup sample reported in Table 1, there were no differences between treated and control LTFU mothers at the 5% significance level.

We take two approaches to account for attrition. First, we present estimates of the main results using Inverse Probability Weighting, where the weights were calculated as

[7] 90% of the time, it is the mother-in-law.

the predicted probability of being in the 7-year followup sample based on the available baseline controls. Second, we include attrition bounds based on Lee (2009) without tightening using covariates. However, the bounds were similar using the perceived social support, SES, and grandmother at baseline as controls for attrition bounding since these were the baseline characteristics that were most likely to predict attrition. Including these controls moved the bounds closer to zero, indicating that the controls were not strongly predicting attrition.[8]

5 Results

5.1 Short-term effects

We first present results on the short-term effects of the intervention, measured at the 6-month and 1-year followups. Table 2 shows the effects of the intervention on parenting behavior or inputs to child well-being in Panel A and child health outcomes in Panel B.[9] Column 4 shows the covariate adjusted treatment effects, though we note that controlling for covariates has minor impacts on point estimate magnitudes or standard errors. Our results indicate that treated mothers were more likely, by 9 percentage points, to be exclusively breastfeeding at the 6-month followup; however, there are no statistical differences in breastfeeding practices by 1-year. On the other hand, we see large and significant effects on the frequency of *both* mother and father play at the 1-year followup (this outcome was not measured at the 6-month followup).

5.2 Child outcomes at age 7

Table 3 shows the effect of the intervention on child development, measured along the three broad domains. Column 1 shows the point estimates on the treatment indicator without controlling for baseline covariates, while Column 3 includes all baseline controls. Columns 2 and 4, show the FWER-adjusted p-values.

Our results indicate that there are no detectible effects along any of the child development domains. The point estimates on cognitive and socio-emotional development are negative. As in the short-run effects, the inclusion of covariates has little effect

[8]We take as the original sample the women whose children were "interviewed" in the 1-year followup of the THP, since this was the starting sample that was targeted for re-enrollment in the SB followup. The overall attrition from baseline was 35%. Another attrition analysis could be preformed using the baseline sample of women at the start of THP, though this would include two types of attrition: attrition during THP and attrition due to not being located for the SB followup. In fact, we may be more concerned about the first type of attrition, since women who did not benefit or were adversely affected by the CBT intervention could have left the sample at that point and biased our estimates of short-term effects upwards. However, attrition between baseline and the 1-year followup was not differential to treatment status (column 6, Table 1).

[9]As the number of outcomes at each followup is relatively small, we do not aggregate the outcomes into indices or correct for multiple hypothesis testing at this stage.

on the estimates. Based on the estimates in the specification with full baseline controls, we are able to reject positive effect sizes greater than 0.08 standard deviations in cognitive development, 0.23 standard deviations in physical development, and 0.05 standard deviations in socio-emotional development.

5.3 Parenting behavior at age 7

6 Discussion

Summing up: we find no detectible effects on child outcomes at age 7, and we are able to reject improvements in the socio-emotion domain, the one most likely to be effected based on non-depressed comparison, on the order of 0.05 standard deviations in the baseline model (0.12 standard deviations using Lee bounds, 0.03 standard deviations using difference-in-difference model with non-depressed, and 0.14 standard deviations in the 2SLS interpretation).

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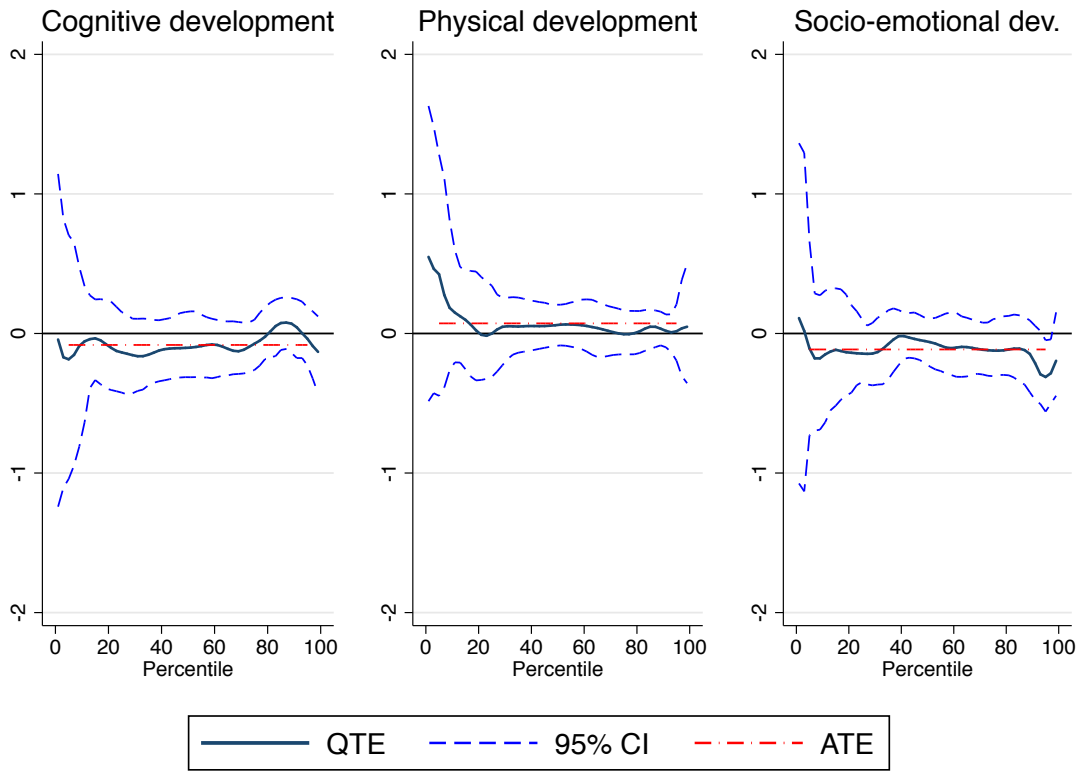
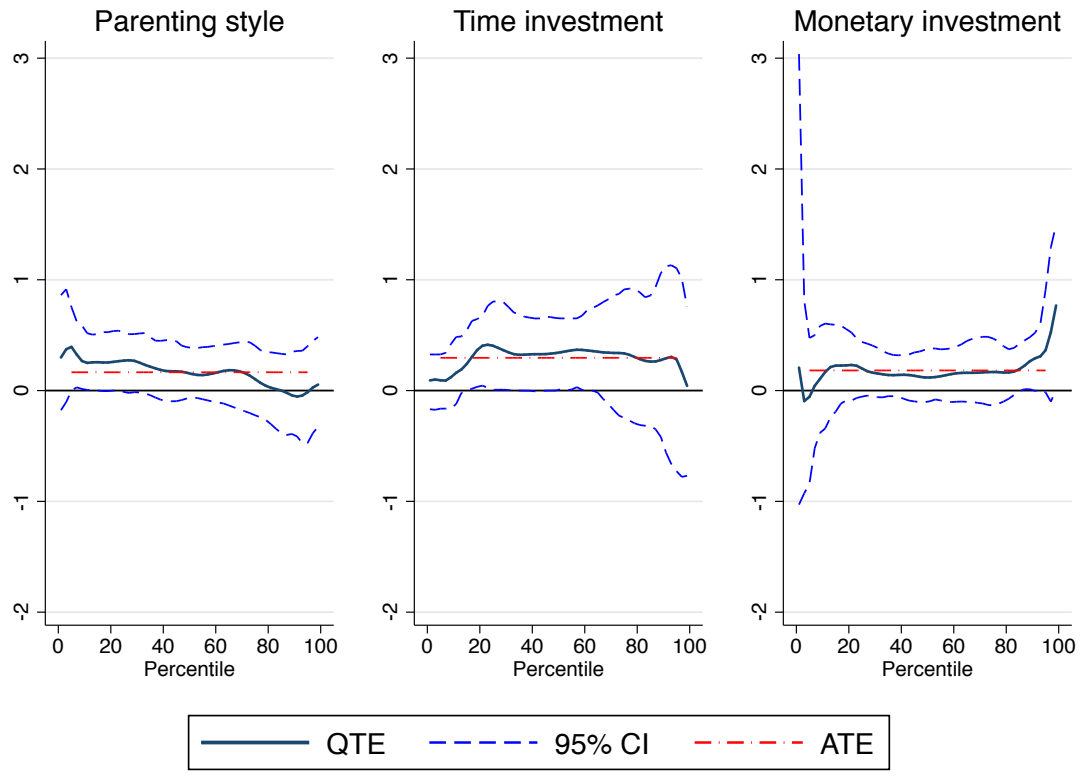
Figure 1 – Quantile Treatment Effects at the 7-year followup

(a) Child outcomes



(b) Parenting behavior



Notes: Quantile Treatment Effects of THP Intervention on child outcomes and parenting behavior at the 7 year followup. More positive values indicate more favorable outcomes. 95% confidence intervals for the QTE were calculated by bootstrapping using 1,000 replications with replacement, clustering at the UC level. The average treatment effect (ATE), the mean difference, is presented for comparison.

Table 1 – Balance and Attrition: Characteristics of intervention and control clusters for 1-year and 7-year follow-up samples

	1-year followup sample: $N = 704$					7-year followup sample: $N = 585$				
	Intervention		Control			Intervention		Control		
	mean	(s.d.)	mean	(s.d.)	p-value	mean	(s.d.)	mean	(s.d.)	p-value
Mother's characteristics and mental health										
Mother's age	26.55	(4.8)	27.02	(5.0)	0.21	26.66	(4.8)	27.07	(5.1)	0.31
Mother's education	4.35	(4.0)	3.77	(3.9)	0.05**	4.31	(3.9)	3.81	(3.9)	0.12
Parity	2.13	(1.7)	2.37	(1.8)	0.06*	2.11	(1.7)	2.40	(1.8)	0.05**
Mother's height (cm)	157	(5.5)	156	(5.5)	0.28	157	(5.5)	156	(5.4)	0.31
Mother's BMI	23.27	(4.0)	23.20	(4.1)	0.83	23.31	(4.0)	23.05	(4.1)	0.45
Hamilton depression score	14.77	(4.1)	14.37	(3.9)	0.19	14.74	(4.2)	14.24	(3.9)	0.14
BDQ disability score	8.08	(2.7)	8.27	(2.7)	0.34	8.08	(2.8)	8.17	(2.7)	0.72
Perceived social support score	46.38	(16.0)	44.39	(16.1)	0.10	47.45	(16.5)	44.61	(16.3)	0.04**
Household characteristics										
Joint/extended family structure	0.61	(0.5)	0.56	(0.5)	0.12	0.62	(0.5)	0.56	(0.5)	0.13
Grandmother lives with	0.55	(0.5)	0.44	(0.5)	0.00***	0.55	(0.5)	0.44	(0.5)	0.01***
No. member per room	3.60	(1.5)	3.73	(1.6)	0.25	3.54	(1.5)	3.74	(1.6)	0.11
Father's education	7.08	(3.9)	7.20	(3.9)	0.67	6.96	(3.8)	7.21	(3.8)	0.43
Father employed	0.89	(0.3)	0.91	(0.3)	0.50	0.90	(0.3)	0.90	(0.3)	0.88
Father non-manual worker	0.29	(0.5)	0.30	(0.5)	0.86	0.28	(0.5)	0.30	(0.5)	0.76
log(Income)	4.19	(3.0)	4.04	(2.9)	0.50	4.29	(3.1)	4.21	(3.0)	0.75
SES (1=Rich, 5=Poor)	3.57	(1.0)	3.65	(1.0)	0.33	3.55	(1.0)	3.63	(1.0)	0.32
Wealth Index[a]	0.12	(2.0)	-0.13	(1.9)	0.09*	0.20	(2.0)	-0.06	(1.9)	0.11
LTFU (from 1-year followup, $N = 704$)						0.19	(0.4)	0.14	(0.4)	0.12
LTFU (from baseline, $N = 903$)[b]						0.38	(0.5)	0.33	(0.5)	0.13
Joint test (p-value)					0.05*					0.00***
Observations	357		347		704	289		296		585

* p < 0.1, ** p < 0.05, *** p < 0.01.

Notes: This table tests for balance along a number of baseline characteristics among the 1-year followup sample (Rahman et al., 2008), and in the 7-year followup sample. Columns show the means and standard deviations (in parentheses) as noted, by intervention arm for the 1-year followup and 7-year followup samples. The p-value of the difference between intervention and control for each sample is also reported.

[a] The wealth index is a PCA-weighted index of household income, health worker SES rating, house materials, water and waste infrastructure, and a number of other assets.

[b] Lost-to-followup (LTFU) calculations based on the number of women at baseline. The number of mothers in the intervention group was 463, and 440 in the control group. This attrition rate includes attrition during the THP trial as well as the attrition between THP and 7-year followup. The overall attrition rate from the baseline group was 35%. The women followed up at 7-years were only those mother-child dyads that were interviewed at the THP 1-year followup.

Table 2 – Treatment effects at 6 and 12 months: Inputs to child well-being and child outcomes

	Sample means		Treatment effect	
	Intervention	Control	Unadjusted	Adjusted
Variable	(1)	(2)	(3)	(4)
	Panel A: Inputs to child well-being			
Exclusive breastfeeding (6mo)[a]	0.20	0.11	0.085*	0.091*
Breastfeeding (12mo)	0.81	0.79	0.023	0.031
Mother play frequency with infant (12mo)[ab]	2.73	2.38	0.35***	0.31***
Father play frequency with infant (12mo)[ab]	2.56	2.28	0.29***	0.25**
Discussed child's development with family (12mo)	0.23	0.14	0.089	0.075*
Selected appropriate place for delivery	0.92	0.75	0.18***	0.17***
Arranged transport for delivery	0.91	0.70	0.21***	0.20***
Arranged finances for delivery	0.91	0.75	0.17***	0.15***
Practicing birth spacing	0.65	0.55	0.100**	0.12***
	Panel B: Child outcomes			
Child weight KG (6mo)[a]	6.71	6.81	−0.11	−0.12
Child weight KG (12mo)[a]	8.15	8.24	−0.088	−0.088
Child length CM (6mo)[a]	64.97	65.11	−0.15	−0.097
Child length CM (12mo)[a]	72.22	71.96	0.26	0.32
Diarrhea episodes (6mo)	0.37	0.44	−0.077*	−0.058
Diarrhea episodes (12mo)[a]	0.34	0.41	−0.073	−0.064
Acute Respiratory Infection (6mo)	0.40	0.44	−0.036	−0.025
Acute Respiratory Infection (12mo)	0.28	0.52	−0.25***	−0.25***
Observations	289	296	585	585

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: This table reports the effect of the intervention on short-term parental investment and child outcomes at 6 and 12 months. Columns 1 and 2 show sample means by randomization arm. Columns 3 and 4 show the treatment effects, estimated using OLS, without and with adjustments for baseline demographic characteristics (controls). Heterogeneity robust standard errors, clustered by Union Council, in parentheses. Additional controls include baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared.

[a] These outcomes were reported in Rahman et al. (2008) using random effects models to account for clustering and using a different set of covariates.

[b] Measured on a 5-point scale, 0=not at all, 1=a few times a month, 2=multiple times a week, 3=almost daily, 4=several times daily. Results are similar using a binary indicator of if parent played with infant at all.

[c] Measured with a 5-point Likert scale where 1=very poor, 5=very good.

Table 3 – Child development outcomes at age 7 by broad domains

			All Baseline Controls	
	(1) Coeff (s.e.)	(2) FWER p-value	(3) Coeff (s.e.)	(4) FWER p-value
Cognitive development index	−0.03	0.78	−0.08	0.60
	(0.09)		(0.08)	
Physical development index	0.08	0.63	0.07	0.60
	(0.08)		(0.08)	
Socio-emotional development index	−0.11	0.47	−0.11	0.42
	(0.08)		(0.08)	

* p < 0.1, ** p < 0.05, *** p < 0.01.

Notes: N=585. Index variables were created following Anderson (2008), with positive values always associated with positive outcomes for all indices. Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All regressions include interviewer fixed effects. Column 3 includes further controls for baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton, BDQ, MSPSS scores and their squares, and interview date. Columns 2 and 4 calculate the p-values controlling for the family-wise error rate (FWER) using a free step-down resampling method.

Table 4 – Child development: Difference-in-difference

	Coefficient on		
	(1) Treat	(2) Treat × Prenatally Depressed	(3) Prenatally Depressed
Cognitive development index	0.08	−0.16	0.08
	(0.13)	(0.14)	(0.09)
Physical development index	−0.04	0.11	−0.15
	(0.10)	(0.14)	(0.10)
Socio-emotional development index	0.06	−0.19*	−0.17*
	(0.11)	(0.11)	(0.09)

* p < 0.1, ** p < 0.05, *** p < 0.01.

Notes: N=885. Sample includes children of mothers who were depressed at baseline as well those who were not depressed at baseline, in both treatment and control clusters. Index variables were created following Anderson (2008), with positive values always associated with positive outcomes for all indices. Heteroskedasticity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects, age of mother and its square, father's and mother's education, parity, and the date of interview.

Table 5 – Heterogeneous treatment effects at 7 years: Child development

	Coefficient on		
	(1) Treat	(2) Treat × Girl	(3) Girl
Cognitive development index	−0.06	−0.05	0.15
	(0.11)	(0.18)	(0.14)
Physical development index	0.05	0.04	−0.05
	(0.11)	(0.14)	(0.10)
Socio-emotional development index	−0.23*	0.24	−0.15
	(0.12)	(0.18)	(0.12)
	Coefficient on		
	(1) Treat	(2) Treat × Grandmother absent	(3) Grandmother absent
Cognitive development index	−0.10	0.05	−0.08
	(0.08)	(0.16)	(0.11)
Physical development index	0.11	−0.08	−0.14
	(0.10)	(0.15)	(0.12)
Socio-emotional development index	−0.04	−0.14	−0.08
	(0.12)	(0.17)	(0.14)
	Coefficient on		
	(1) Treat	(2) Treat × Parents' avg education	(3) Parents' avg education
Cognitive development index	0.17	−0.04*	0.10***
	(0.17)	(0.02)	(0.03)
Physical development index	0.09	−0.00	0.02
	(0.18)	(0.03)	(0.03)
Socio-emotional development index	−0.23	0.02	0.05*
	(0.18)	(0.03)	(0.03)
	Coefficient on		
	(1) Treat	(2) Treat × Wealth index	(3) Wealth index
Cognitive development index	−0.06	−0.01	0.06*
	(0.08)	(0.05)	(0.03)
Physical development index	0.07	−0.01	0.04
	(0.08)	(0.03)	(0.02)
Socio-emotional development index	−0.13*	0.08**	0.00
	(0.07)	(0.04)	(0.03)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: N=585. Index variables were created following Anderson (2008), with positive values always associated with positive outcomes for all indices. Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects as well as additional controls for baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton, BDQ, MSPSS scores and their squares, and date of the interview.

Table 6 – Parenting behavior at 7-year followup by broad domains

			All Baseline Controls	
	(1) Coeff (s.e.)	(2) FWER p-value	(3) Coeff (s.e.)	(4) FWER p-value
Parenting style index	0.15*	0.07*	0.12*	0.09*
	(0.08)		(0.07)	
Time investment index	0.17**	0.04**	0.16**	0.08*
	(0.07)		(0.07)	
Monetary investment index	0.22**	0.04**	0.17*	0.09*
	(0.09)		(0.09)	

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: N=585. Index variables were created following Anderson (2008), with positive values always associated with positive outcomes for all indices. Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects, and columns 3 and 4 contain additional controls for baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton, BDQ, MSPSS scores and their squares, and date of the interview. Columns 2 and 4 calculate the p-values controlling for the family-wise error rate (FWER) using a free step-down resampling method.

Table 7 – Parenting behavior: Difference-in-difference specification

	Coefficient on		
	(1) Treat	(2) Treat × Prenatally Depressed	(3) Prenatally Depressed
Parenting style index	−0.12	0.25*	−0.19*
	(0.14)	(0.13)	(0.10)
Time investment index	−0.04	0.19*	−0.15*
	(0.11)	(0.11)	(0.08)
Monetary investment index	0.10	0.08	−0.05
	(0.11)	(0.12)	(0.07)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: N=885. Sample includes children of mothers who were depressed at baseline as well those who were not depressed at baseline, in both treatment and control clusters. Index variables were created following Anderson (2008), with positive values always associated with positive outcomes for all indices. Heteroskedasticity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects, age of mother and its square, father's and mother's education, parity, and the date of interview.

Table 8 – Heterogeneous treatment effects at 7 years: parenting

	Coefficient on		
	(1) Treat	(2) Treat × Girl	(3) Girl
Parenting style index	−0.10	0.41***	−0.02
	(0.11)	(0.14)	(0.12)
Time investment index	0.11	0.08	−0.00
	(0.10)	(0.13)	(0.11)
Monetary investment index	0.09	0.17	−0.22**
	(0.11)	(0.14)	(0.10)
	Coefficient on		
	(1) Treat	(2) Treat × Grandmother absent	(3) Grandmother absent
Parenting style index	0.08	0.07	−0.08
	(0.10)	(0.14)	(0.12)
Time investment index	0.04	0.22*	−0.07
	(0.09)	(0.12)	(0.11)
Monetary investment index	0.12	0.09	−0.01
	(0.12)	(0.15)	(0.13)
	Coefficient on		
	(1) Treat	(2) Treat × Parents' avg education	(3) Parents' avg education
Parenting style index	0.15	−0.01	0.09**
	(0.16)	(0.03)	(0.04)
Time investment index	0.26*	−0.02	0.05**
	(0.13)	(0.02)	(0.02)
Monetary investment index	0.15	0.00	0.07*
	(0.20)	(0.03)	(0.03)
	Coefficient on		
	(1) Treat	(2) Treat × Wealth index	(3) Wealth index
Parenting style index	0.11*	0.00	0.05*
	(0.07)	(0.03)	(0.02)
Time investment index	0.16**	−0.02	0.09***
	(0.07)	(0.04)	(0.02)
Monetary investment index	0.19**	0.02	0.06**
	(0.09)	(0.04)	(0.03)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: N=585. Index variables were created following Anderson (2008), with positive values always associated with positive outcomes for all indices. Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects as well as additional controls for baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared, and date of the interview.

Appendices: For Online Publication

A Maternal Depression and Child Outcomes: Psychology Literature Review

We outline a number of mechanisms by which maternal perinatal depression may impact child development. Evidence suggests that there are critical periods in child development and exposure to shocks would have different impacts on the child depending on when they were realized. Thus, we summarize the potential mechanisms, based on the review by Sohr-Preston and Scaramella (2006), for three time periods: prenatal, postpartum, and later infancy onwards. While the mothers in our sample were all depressed prenatally, the experiment only changed the likelihood of postpartum depression onwards. There is strong autocorrelation in depression, such that many of the mothers who experience depression prenatally will continue to have depressive episodes postpartum. (CITE, XXX of postpartum depression started prenatally.)

During the prenatal period, maternal depression may influence the fetus through direct physiological effects as well as behavioral effects. Depression may effect mothers' behavior by altering sleep patterns and nutritional intake. For example, depressed mothers may not gain enough weight (Walker, Cooney, and Riggs 1999). Furthermore, they are less likely to seek prenatal care (Miller 1992). Physiological effects of depression are likely as well, as maternal depression and stress is associated with elevated cortisol, which has been linked to slower fetal growth and premature birth, and prenatal maternal cortisol levels play a role in mediating these outcomes (Diego et al., 2009). Moreover, the level of cortisol which fetuses are exposed to during pregnancy may affect the development of the hypothalamic-pituitary-adrenal (HPA) axis, which is the system responsible for modulating cortisol. Thus, depression during pregnancy may program the fetal HPA axis to be more receptive to stress, resulting in children becoming easily over-aroused in nonthreatening situations (Sohr-Preston and Scaramella, 2006).

Depression during the postpartum period, defined roughly as the first six weeks after birth, may also have distinct effects on child development apart from those in the prenatal period. Depression in the postpartum period may also have both physiological and behavioral effects. Newborn infants of depressed mothers have distinct biological response patters: lower cardiac vagal tone and concerning patterns of electrical brain activity, which are associated with reduced self-regulation and emotional expression in later development.Depressed mothers are likely to experience more stress and anxiety, which is associated with chronically elevated cortisol levels, which are passed through to the infant via breastmilk (CITES). Behaviorally, mothers suffering from postpartum depression are less behaviorally consistent, less positive, more negative, and use too little or overly excessive levels of stimulation (Sohr-Preston and Scaramella, 2006). They also breastfeed significantly less frequently (Campbell and Cohn 1997, Field 2002). To the extent that breastfeeding improves the development of the infant's immune system, postpartum depression may also impact the child's frequency of illness and physical health.[10] Mothers who are more severely depressed in the newborn period express more

[10]Interestingly, reduced breastfeed and touch activate the release of oxytocin, commonly referred to as the bonding hormone, making it more difficult for mothers to bond with her infant. Furthermore, the infant may also be more

negative affect, touch their infants significantly less (thereby reducing bonding and oxytocin release, Apter-Levy et al. (2013); Feldman et al. (2010)), and use infant directed speech less effectively, which are important for early child learning.[11] Furthermore, early touch appears to have lasting effects on cognitive development, possibly by stimulating cortical growth and synaptic proliferation in the brain (Caulfield 2000, Weiss, Wilson, and Morrison 2004).

Depression may persist beyond the postpartum period, thus directly influencing parenting behavior in later infancy. Chronically depressed mothers may experience greater depletion of energy to cope with the everyday demand of parenting. For example, they exhibit a drop in observed sensitivity, or responsiveness to the child, from 15 to 24 months. Maternal sensitivity accounts for differences in school readiness and verbal competency between children of depressed and non-depressed mothers (NICHI Early Child Care Research Network 1999). The mother may be inconsistent with her responding, failing to provide children with opportunities to perceive order and predictability in their environment (Hay 1997). Furthermore, depressed mothers are less able to engage in effective play (Tingley 1994) and other learning interactions with the child.

More broadly, maternal depression may influence the home environment. Mothers may invest less in stimulating toys for the child. Additionally, relationships between the mother and her husband, older children, and mother-in-law may become strained.

In principle, maternal depression may also affect fertility, either through the channel of breastfeeding, reducing spacing between births if depressed mothers breastfeed less, or by reducing sex drive, which would have the opposite effect. Furthermore, maternal depression may impact contraceptive use through effort costs or time preferences.[12]

From the perspective of economic theory, maternal depression may affect mothers' risk and time preferences, aspirations, and cost of effort, which in turn would decrease investment (actions, like those described in the above paragraphs, that the mother must take to ensure the optimal development of her child) in the human capital of her child at all stages of development. In addition, the optimal investment decisions of the parents might change if they believe the prenatal and postpartum depression negatively affected the human capital endowment of the child. Parents may display compensatory behavior (by investing more in their child) if they are inequality averse, or may display reinforcing investment behavior (and invest less) because of static complementarity (Becker and Tomes, 1986).

Lastly, maternal depression may impact household bargaining if depression reduces the mothers' capacity to bargain effectively. Thus, investment allocations by gender may differ between depressed and non-depressed mothers if mother's and father's preferences are not the same.

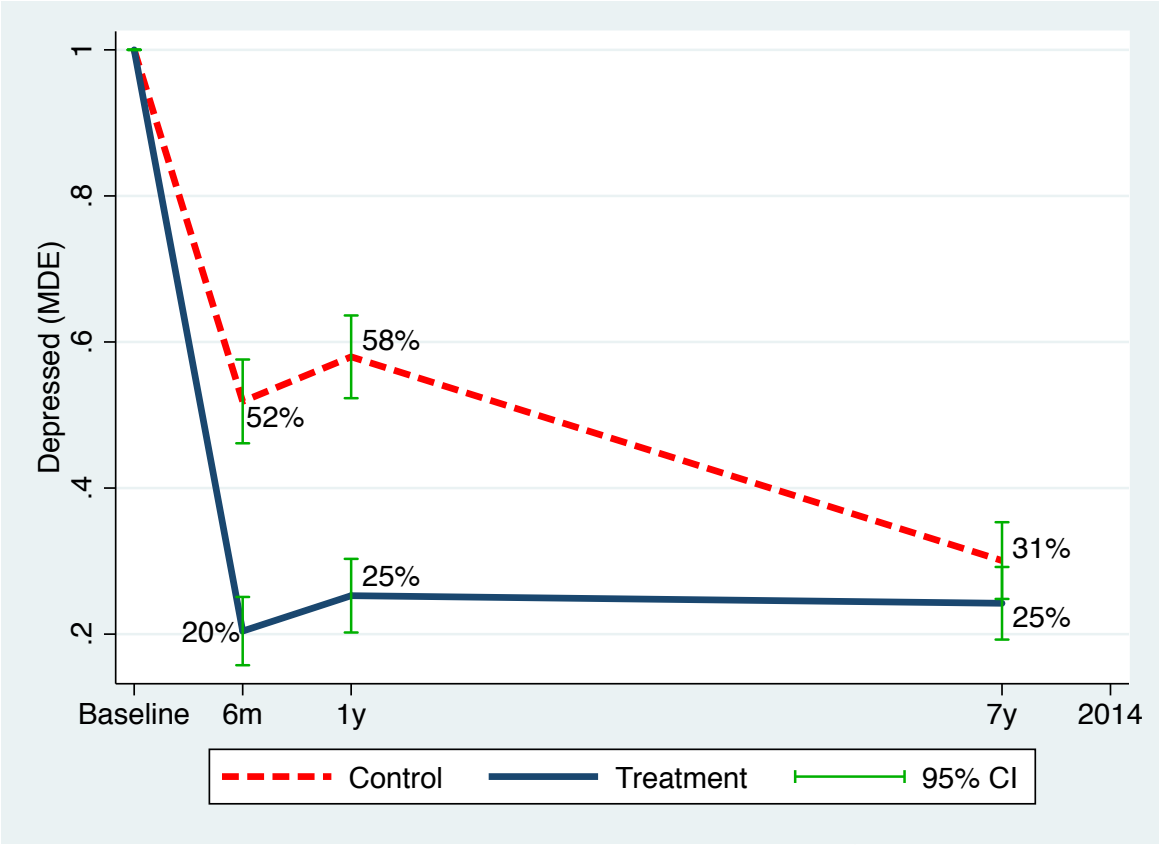
B Appendix Figures

irritable, unpredictable, and more difficult, potentially intensifying or maintaining maternal depressed mood.

[11] For example, infants may be more vulnerable to learning difficulties because increased maternal negative affect elevates infants' arousal in a way that interferes with early learning efforts (Sohr-Preston and Scaramella, 2006).

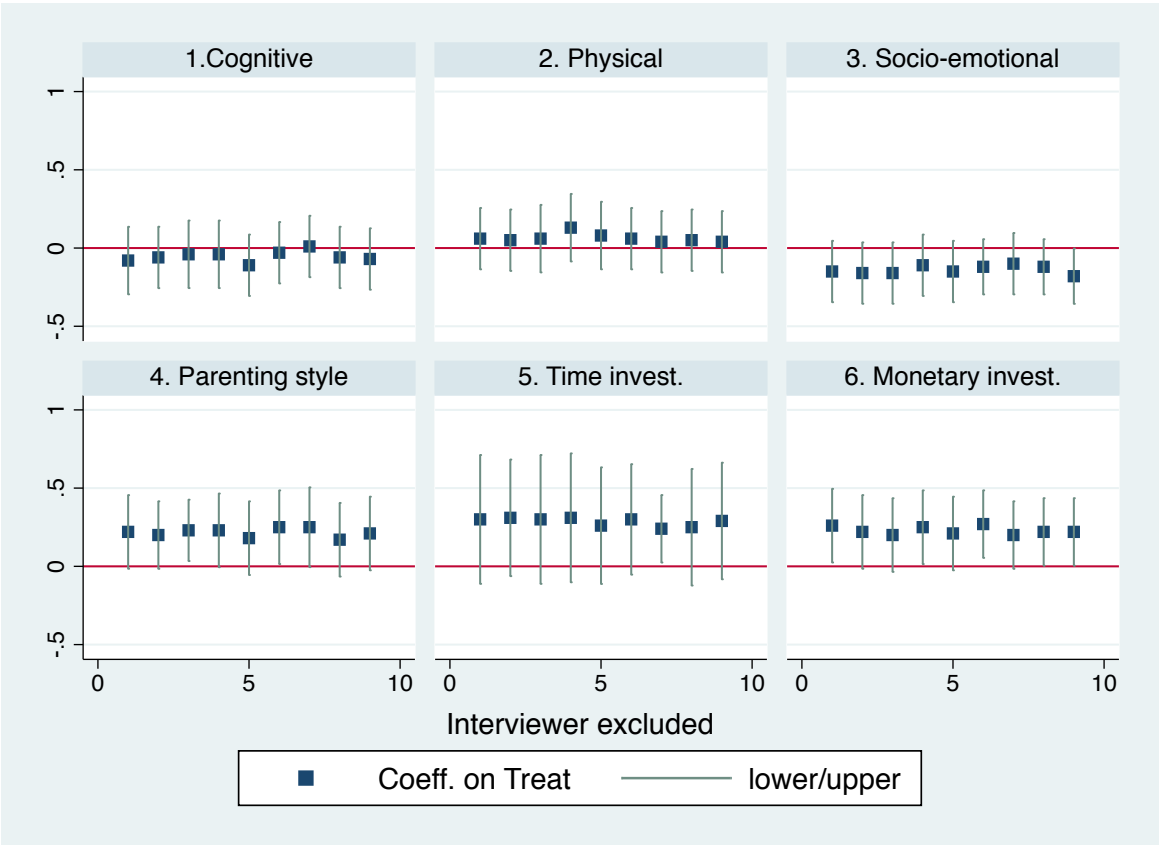
[12] Ifcher and Zarghamee (2011) show that mood affects time preferences. Thus depression, which is accompanied by more negative affect and less positive affect, may increase the mother's discount rate or make her more present-biased.

Figure B.1 – Maternal Depression Trends from baseline until the 7-year Follow-up (2005-2013)

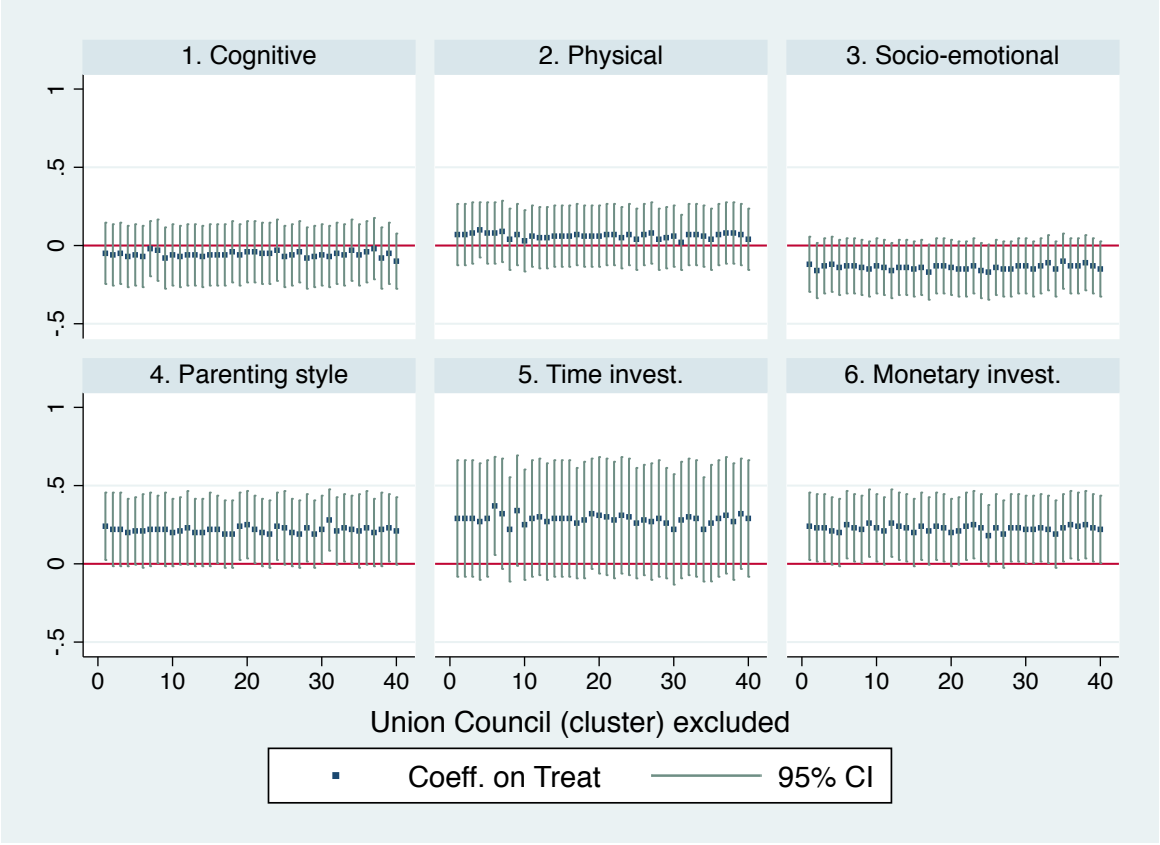


Notes: Figure plots whether mother was evaluated to be depressed based on the SCID, evaluated by a clinician, at all available points in time (raw data), for treatment and control groups.

Figure B.2 – Treatment effects excluding individual interviewers and clusters



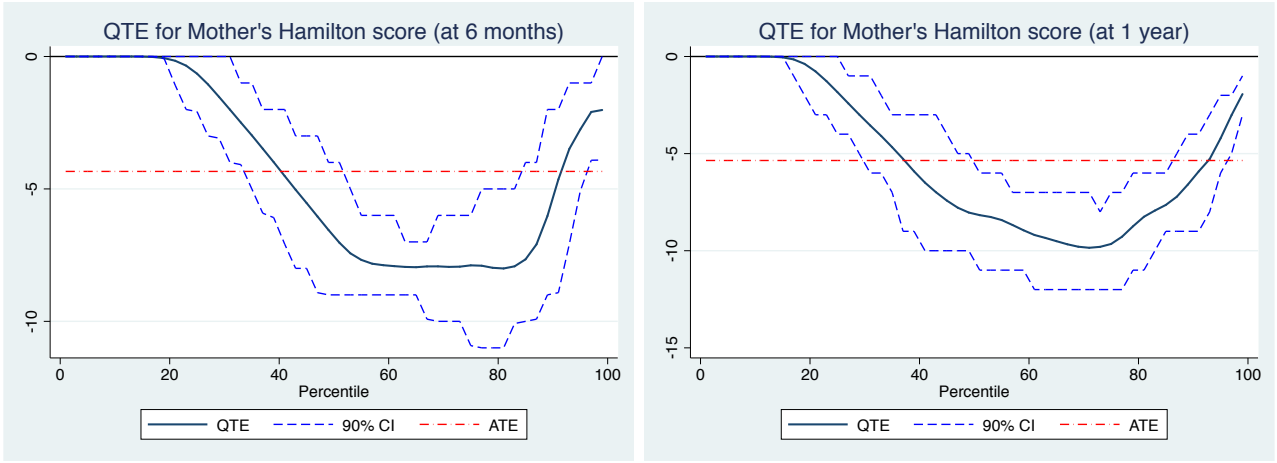
(a) Excluding interviewers



(b) Excluding Union Councils (clusters)

Notes: Treatment effects, measured in standard deviations from the control group mean, for broad domains of child development and parenting calculated by excluding either each interviewer or each cluster. Heteroskedasticity robust standard errors, clustered at the Union Council level, are used to construct the 95% confidence intervals. Regressions do not contain any controls.

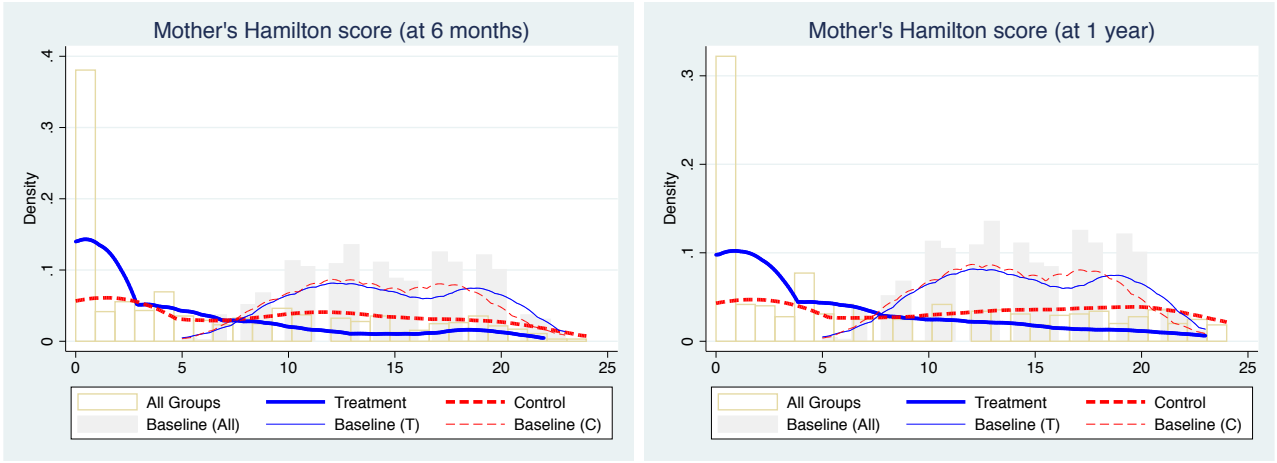
Figure B.3 – Quantile Treatment Effects of THP Intervention on maternal depression



(a) QTE estimates on Hamilton score (6 month) **(b)** QTE estimates on Hamilton score (1 year)

Notes: Quantile Treatment Effects of THP Intervention on maternal depression severity, measured by the Hamilton depression rating (where higher values indicate more severe depression). 90% confidence intervals for the QTE were calculated by bootstrapping using 1,000 replications with replacement, clustering at the UC level. The average treatment effect (ATE), the mean difference, is presented for comparison.

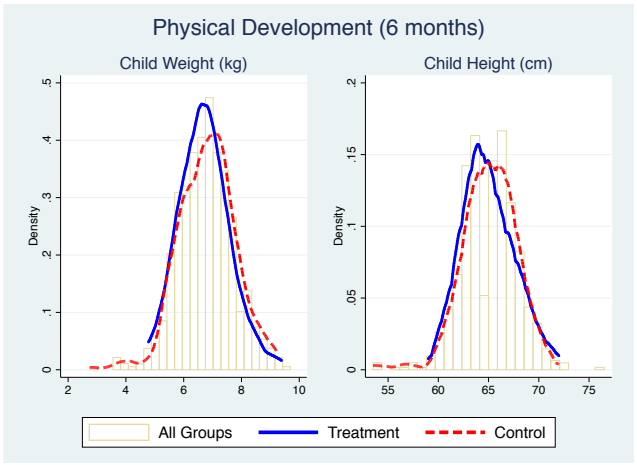
Figure B.4 – Depression severity: maternal Hamilton depression scores at 6 months and 1 year



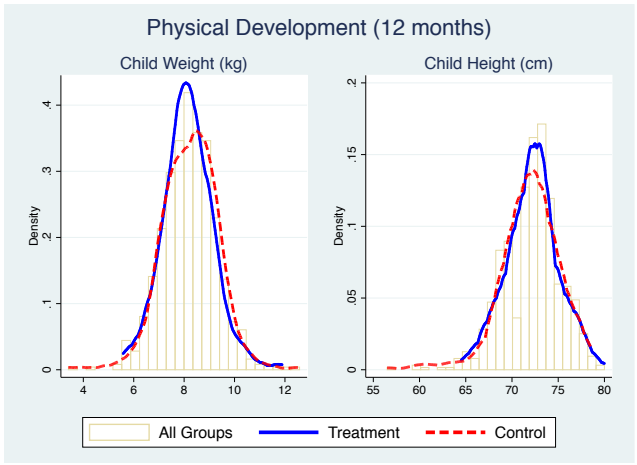
(a) Density of Hamilton score at 6 months **(b)** Density of Hamilton score at 1 year

Notes: Maternal depression, measured using the Hamilton depression score, with higher values indicating more severe depression, at the 6-month and 1-year followups by treatment arm. Baseline distributions for treatment and controls arms are also plotted for comparison. Histograms of the data for combined groups (treatment and control) at baseline and the followups are plotted in the background.

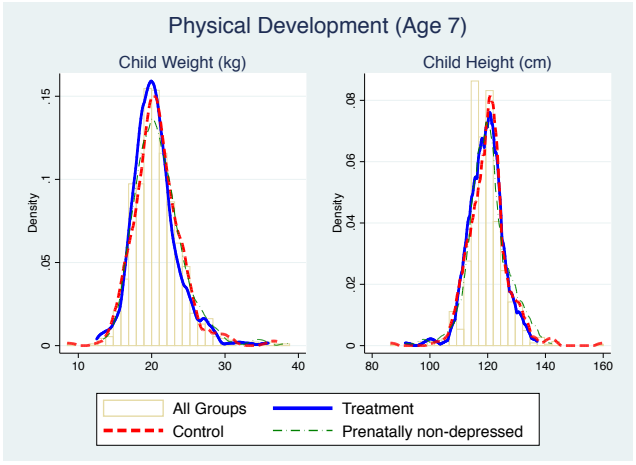
Figure B.5 – Child growth at 6 months, 1 year, and 7 years of age



(a) Child height and weight (6 months)



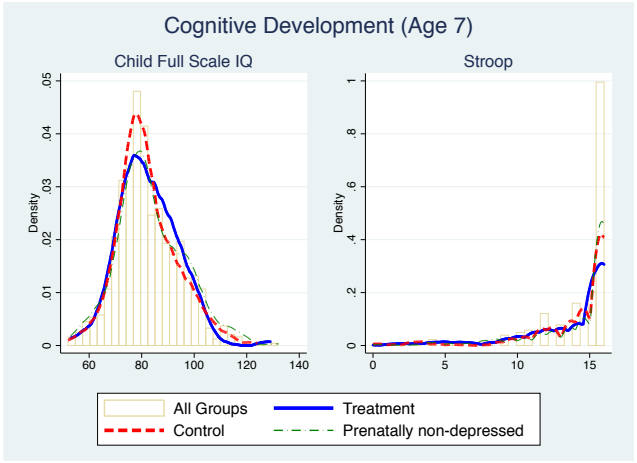
(b) Child height and weight (12 months)



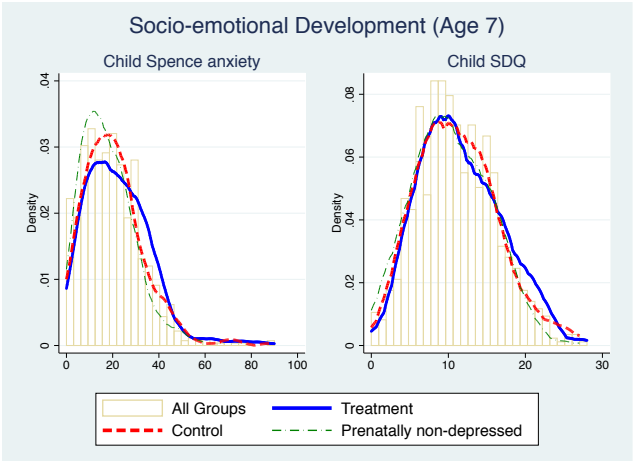
(c) Child height and weight (7 years)

Notes: Distributions of child weight (kg) and height (cm) measurements at 6-month, 1-year, and 7-year followups (infants were approximately 6 months and 12 months old at these followups). Histograms of the data for all groups combined (treatment and control, and non-depressed where available) are plotted in the background. Panel (c) include the children of perinatally non-depressed mothers.

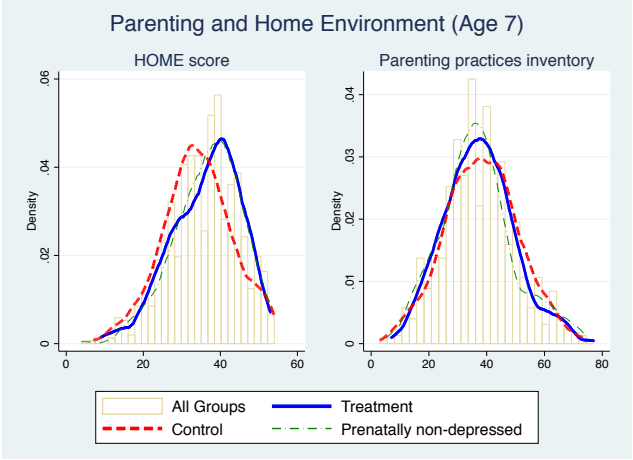
Figure B.6 – Distributions of key outcomes at the 7 year followup



(a) Cognitive development



(b) Socio-emotional development



(c) Parenting and home environment

Notes: Distributions of child outcomes at the 7 year followup for main outcome variables, by treatment arm. Distributions for prenatally non-depressed mothers are also plotted for comparison. Histograms of the data for all groups combined (treatment, control, and non-depressed) are plotted in the background.

C Appendix: Additional results

Table C.1 – Treatment effects at 6 and 12 months: Maternal depression and wellbeing outcomes

	Sample means		Treatment effect (ITT)	
	Intervention	Control	Unadjusted	Adjusted
Variable	(1)	(2)	(3)	(4)
Depressed (6mo)	0.20	0.52	-0.31***	-0.30***
Depressed (12mo)	0.25	0.58	-0.33***	-0.31***
Hamilton depression score (6mo)	4.13	8.44	-4.30***	-4.17***
Hamilton depression score (12mo)	5.04	10.59	-5.55***	-5.26***
BDQ disability score (6mo)	2.15	4.09	-1.94***	-1.78***
BDQ disability score (12mo)	2.07	5.20	-3.13***	-2.98***
GAF score (6mo)	79.69	72.17	7.52***	7.25***
GAF score (12mo)	78.42	69.39	9.03***	8.58***
Perceived social support score (6mo)	51.62	43.96	7.66***	6.77***
Perceived social support score (12mo)	51.30	42.90	8.41***	7.32***
Observations	289	296	585	585

* $p < .10$, ** $p < .05$, *** $p < .01$

Notes: This table replicates the results in the Rahman et al. (2008) study, using the sample of women that were found for the 7 year followup. Columns 1 and 2 show sample means by randomization arm. Columns 3 and 4 show the treatment effects, estimated using OLS, without and with adjustments for baseline demographic characteristics (controls). Heterogeneity robust standard errors, clustered by Union Council, in parentheses. Additional controls include baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared. The controls used here are the same as used in the rest of the analysis, though they are different from those used in Rahman et al. (2008).

Table C.2 – Child Outcomes at Age 7 by Maternal Prenatal Depression Status

	(1) Depressed	(2) Non-depressed	(3) Difference	(4) P-value
Panel A: Raw means and differences				
Cognitive development index	−0.07	0.07	−0.13	0.11
Physical development index	−0.06	0.06	−0.12	0.14
Socio-emotional development index	−0.12	0.11	−0.23	0.00***
Stunted (Height<-2SD)	0.14	0.11	0.04	0.19
Thin (BMI<-2SD)	0.19	0.15	0.04	0.20
Severe illness	0.31	0.23	0.08	0.03**
Hospitalized	0.19	0.13	0.07	0.03**
Spence anxiety	20.36	17.57	2.79	0.01**
SDQ	11.12	10.35	0.78	0.07*
Child Full Scale IQ	82.13	83.64	−1.51	0.13
Stroop	14.19	14.30	−0.11	0.64
Private school	0.39	0.51	−0.12	0.00***
Urdu	6.40	7.30	−0.89	0.00***
Math	9.09	9.70	−0.60	0.04**
Educ Expenditure	2187	2588	-401	0.15
Expected grade attainment	14.07	14.74	−0.66	0.00***
Panel B: Controlling for baseline demographics				
Cognitive development index	−0.02	−0.03	0.02	0.84
Physical development index	−0.06	0.07	−0.12	0.11
Socio-emotional development index	−0.14	0.08	−0.23	0.00***
Stunted (Height<-2SD)	0.12	0.12	0.00	0.91
Thin (BMI<-2SD)	0.19	0.15	0.03	0.26
Severe illness	0.31	0.23	0.08	0.01**
Hospitalized	0.17	0.12	0.05	0.09*
Spence anxiety score	20.68	17.95	2.73	0.00***
SDQ score	11.23	10.46	0.77	0.04**
Child Full Scale IQ	83.11	82.33	0.78	0.37
Stroop	14.20	14.27	−0.07	0.76
Private school	0.46	0.48	−0.02	0.54
Urdu	6.75	6.83	−0.08	0.78
Math	9.34	9.33	0.01	0.95
Educ Expenditure	2411	2499	−87.70	0.74
Expected grade attainment	14.39	14.57	−0.18	0.33
Observations	296	300	596	596

* $p < .10$, ** $p < .05$, *** $p < .01$

Notes: This table shows means and differences of child outcomes at age 7 by perinatal depression status. Panel A shows the raw means and differences, whereas Panel B shows the differences after controlling for all baseline controls in the DD estimates: mother's age, its square, parental education, number of kids, interviewer and UC fixed effects. The difference between Panel A and B is largely driven by controls for parental education. Column 1 shows characteristics of children from mothers in the control arm of the trial, Column 2 shows child outcomes for mothers who were not prenatally depressed. Column 3 shows the differences, and Column 4 shows the p-value of the difference in means between the two groups.

Table C.3 – Child development and parenting behavior outcomes at age 7: Wild-t bootstrapped clustering

	No controls	Interviewer FEs			
	(1) Coeff (s.e.)	(2) Coeff (s.e.)	(3) Naive p-value	(4) Wild bootstrapped p-value	(5) FWER p-value
Panel A: Child development outcomes					
Cognitive development index	−0.05	−0.03	0.77	0.82	0.78
	(0.10)	(0.09)			
Physical development index	0.06	0.08	0.39	0.44	0.63
	(0.10)	(0.08)			
Socio-emotional development index	−0.14	−0.11	0.20	0.25	0.47
	(0.09)	(0.08)			
Panel B: Parenting behavior					
Parenting style index	0.22*	0.15*	0.07*	0.10*	0.07*
	(0.11)	(0.08)			
Time investment index	0.29	0.17**	0.01**	0.02**	0.04**
	(0.18)	(0.07)			
Monetary investment index	0.23**	0.22**	0.02**	0.02**	0.04**
	(0.11)	(0.09)			

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: N=585. Index variables were created following Anderson (2008), with positive values always associated with positive outcomes for all indices. Heterogeneity robust standard errors, clustered by Union Council, in parentheses. Column 1 excludes interviewer fixed effects, but all estimations in Columns 2-5 include interviewer fixed effects. Columns 3 shows naive p-values using the clustered sandwich estimator for standard errors, column 4 shows the p-values based on Cameron et al. (2008)'s wild-t bootstrap method, and column 5 calculates the p-values controlling for the family-wise error rate (FWER) using a free step-down resampling method.

Table C.4 – Child outcomes at age 7: Risk game

	Outcome: Risk Loving				Risk Averse			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treated	−0.034	−0.024	−0.019	−0.020	0.043	−0.025	−0.031	−0.030
	(0.058)	(0.045)	(0.044)	(0.045)	(0.037)	(0.028)	(0.028)	(0.027)
Depr × Treat	0.011				−0.068			
	(0.071)				(0.044)			
Baseline depressed	0.017				0.021			
	(0.049)				(0.031)			
No. people intervened				0.011				−0.0014
				(0.020)				(0.010)
How influenced				−0.049				−0.042**
				(0.036)				(0.016)
Time taken (min)				−0.024				0.0063
				(0.030)				(0.017)
Risk game controls				Y				Y
All baseline controls			Y	Y			Y	Y
Experimental sample only		Y	Y	Y		Y	Y	Y
Interviewer FE	Y	Y	Y	Y	Y	Y	Y	Y
Observations	885	585	585	584	885	585	585	584
Dep. var. mean	0.44	0.45	0.45	0.45	0.18	0.18	0.18	0.18

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Outcomes are binary variables based on the level of risk taken is a risky game. The child got 4 tokens and each token corresponded to a single gift of choice from a gift bag with an assortment of small items such as toys, stationary, beads, hair bands etc. The child had a choice of putting tokens in a risky bowl with 50 percent chance of a good outcome where investment tripled and all was lost if outcome was bad. Alternatively, the child could also place tokens in a risk-free bowl where investment returned a sure outcome of one gift. Child was coded as risk loving if (s)he placed 3 or 4 tokens in the risky bowl, and risk averse if (s)he placed 0 or 1 tokens in the risky bowl. Heterogeneity robust standard errors, clustered by Union Council, in parentheses.

Table C.5 – Effects of maternal depression: 2SLS Results

	First Stage	2SLS					
	(1) Depressed (1-year)	(2) Cognitive Development	(3) Physical Development	(4) Socio-emotional Development	(5) Parenting Style	(6) Parenting Time	(7) Parenting Money
Treated	-0.29^{***}						
	(0.043)						
Depressed at 1-year followup		0.26	-0.22	0.38	-0.41^{**}	-0.52^{***}	-0.59^{**}
		(0.27)	(0.27)	(0.26)	(0.20)	(0.20)	(0.28)
Control mean (dep. var)	0.58	-0.0022	0.0013	-0.000041	-0.0041	0.00018	-0.0049

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: N= 584. Column 1 shows the effect of treatment on depression at the 1-year followup. Columns 2-7 show the effects of perinatal depression, measured at the 1-year followup, on child outcomes and parenting behavior at age 7, instrumenting for depression using treatment assignment. Index variables were created following Anderson (2008), with positive values always associated with positive outcomes for all indices. All regressions control for interviewer fixed effects as well as additional controls for baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared, and date of the interview. Heterogeneity robust standard errors, clustered by Union Council, in parentheses.

Table C.6 – Heterogeneous treatment effects by gender and grandmother at baseline

	Child Development			Parenting		
	(1) Cognitive Development	(2) Physical Development	(3) Socio-emotional Development	(4) Parenting Style	(5) Parenting Time	(6) Parenting Money
Panel A: Girls						
Treated	−0.22*	0.013	0.18	0.30**	0.042	0.26
	(0.12)	(0.095)	(0.19)	(0.14)	(0.11)	(0.21)
Grandmother absent	−0.19	−0.34*	−0.051	−0.11	−0.21	−0.098
	(0.20)	(0.19)	(0.19)	(0.14)	(0.14)	(0.24)
Treat × Grandmo. absent	0.23	0.14	−0.28	0.017	0.26*	0.063
	(0.28)	(0.19)	(0.24)	(0.19)	(0.15)	(0.25)
Observations	296	296	296	296	296	296
Panel B: Boys						
Treated	−0.046	0.17	−0.26	−0.11	0.035	0.034
	(0.13)	(0.18)	(0.17)	(0.14)	(0.12)	(0.14)
Grandmother absent	−0.015	0.086	−0.067	0.061	0.042	0.12
	(0.16)	(0.22)	(0.23)	(0.20)	(0.19)	(0.19)
Treat × Grandmo. absent	−0.042	−0.20	−0.011	−0.055	0.16	0.0089
	(0.20)	(0.31)	(0.24)	(0.19)	(0.19)	(0.24)
Observations	289	289	289	289	289	289

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Grandmother absent at baseline if neither maternal or parent grandparent of index child was not living with the family at baseline. Index variables were created following Anderson (2008), with positive values always associated with positive outcomes for all indices. Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects as well as additional controls for baseline values of age, age-squared, family structure, mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared, and date of the interview.

Table C.7 – Persistence of grandmothers living with families

	Grandmother present at		
	(1) 6-month followup	(2) 1-year followup	(3) 7-year followup
Panel A: Grandmother absent at baseline			
Treated	0.10**	0.073*	0.10**
	(0.043)	(0.041)	(0.044)
Observations	294	294	294
Control mean (dep. var)	0.18	0.085	0.15
Panel B: Grandmother present at baseline			
Treated	0.042	0.048	0.014
	(0.033)	(0.037)	(0.071)
Observations	290	290	291
Control mean (dep. var)	0.85	0.83	0.53

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Grandmother absent at baseline if neither maternal or parent grandparent of index child was not living with the family at baseline. Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects as well as additional controls for baseline values of age, age-squared, family structure, mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared, and date of the interview.

Table C.8 – Mediating factors

	Child Development			Parenting		
	(1) Cognitive Development	(2) Physical Development	(3) Socio-emotional Development	(4) Parenting Style	(5) Parenting Time	(6) Parenting Money
Panel A: Depression						
Treated	−0.087	0.033	−0.15*	0.047	0.096	0.18*
	(0.083)	(0.087)	(0.073)	(0.062)	(0.064)	(0.096)
Depressed at 1-yr	−0.00040	−0.10	−0.074	−0.21**	−0.17**	0.031
	(0.077)	(0.099)	(0.088)	(0.080)	(0.078)	(0.069)
Depressed at 7-yr	−0.26**	−0.038	−0.46***	−0.35***	−0.24***	−0.16*
	(0.11)	(0.11)	(0.090)	(0.080)	(0.072)	(0.090)
Panel B: Presence of grandmother						
Treated	−0.086	0.062	−0.099	0.12*	0.15**	0.17*
	(0.080)	(0.083)	(0.077)	(0.068)	(0.069)	(0.084)
Grandmother present at 1-yr	0.061	0.029	−0.0099	−0.096	−0.066	−0.048
	(0.098)	(0.11)	(0.11)	(0.12)	(0.090)	(0.14)
Grandmother present at 7-yr	0.065	0.014	−0.17	0.065	0.14**	0.091
	(0.097)	(0.10)	(0.10)	(0.091)	(0.067)	(0.095)
Panel C: Social support						
Treated	−0.098	0.081	−0.15*	0.038	0.062	0.13
	(0.084)	(0.082)	(0.074)	(0.066)	(0.071)	(0.093)
MSPSS at 1-yr	0.00018	−0.0018	0.0011	0.0065**	0.0058*	0.0030
	(0.0029)	(0.0033)	(0.0033)	(0.0029)	(0.0034)	(0.0039)
MSPSS at 7-yr	0.0077*	−0.0018	0.011***	0.016***	0.021***	0.0081*
	(0.0043)	(0.0035)	(0.0037)	(0.0034)	(0.0031)	(0.0045)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: N= 584. Index variables were created following Anderson (2008), with positive values always associated with positive outcomes for all indices. Grandmother present is equal to one if either maternal or parent grandparent of index child was living with the family at the time of interview. Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects as well as additional controls for baseline values of age, age-squared, family structure, grandmother present, mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared, and date of the interview.

Table C.9 – Depression trajectories and outcomes

	Child Development			Parenting		
	(1) Cognitive Development	(2) Physical Development	(3) Socio-emotional Development	(4) Parenting Style	(5) Parenting Time	(6) Parenting Money
Depressed at 7-yr	−0.24**	−0.070	−0.44***	−0.35***	−0.33***	−0.15**
	(0.097)	(0.088)	(0.093)	(0.068)	(0.064)	(0.071)
Depressed at baseline	0.037	−0.080	−0.21***	−0.022	−0.013	0.0054
	(0.073)	(0.067)	(0.056)	(0.074)	(0.053)	(0.059)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: N= 877. Sample includes baseline non-depressed mothers. Index variables were created following Anderson (2008), with positive values always associated with positive outcomes for all indices. Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects as well as additional controls for baseline values of age, age-squared, mother's education, father's education, parity, and date of the interview.

Table C.10 – Heterogeneous treatment effects at 7 years: Child development

	Coefficient on		
	(1) Treat	(2) Treat × Father's education	(3) Father's education
Cognitive development index	0.14	−0.03	0.05***
	(0.19)	(0.02)	(0.02)
Physical development index	0.08	−0.00	0.01
	(0.18)	(0.02)	(0.02)
Socio-emotional development index	−0.25	0.02	0.02
	(0.19)	(0.02)	(0.01)
	Coefficient on		
	(1) Treat	(2) Treat × Mother's education	(3) Mother's education
Cognitive development index	0.02	−0.02	0.06***
	(0.12)	(0.02)	(0.01)
Physical development index	0.08	−0.00	−0.01
	(0.11)	(0.02)	(0.02)
Socio-emotional development index	−0.14	0.01	0.01
	(0.11)	(0.02)	(0.02)
	Coefficient on		
	(1) Treat	(2) Treat × Depression severity	(3) Depression severity
Cognitive development index	−0.10	−0.11	0.01
	(0.08)	(0.08)	(0.06)
Physical development index	0.07	0.10	−0.03
	(0.08)	(0.09)	(0.07)
Socio-emotional development index	−0.11	−0.05	−0.05
	(0.08)	(0.07)	(0.04)
	Coefficient on		
	(1) Treat	(2) Treat × Mother's age	(3) Mother's age
Cognitive development index	−0.39	0.01	0.02*
	(0.39)	(0.01)	(0.01)
Physical development index	0.23	−0.00	0.00
	(0.51)	(0.02)	(0.01)
Socio-emotional development index	0.43	−0.02	0.00
	(0.47)	(0.01)	(0.01)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Index variables were created following Anderson (2008), with positive values always associated with positive outcomes for all indices. Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects as well as additional controls for baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared, and date of the interview.

Table C.11 – Heterogeneous treatment effects at 7 years: parenting

	Coefficient on		
	(1) Treat	(2) Treat × Father's education	(3) Father's education
Parenting style index	0.12	0.00	0.04*
	(0.20)	(0.03)	(0.02)
Time investment index	0.32**	−0.02	0.03**
	(0.15)	(0.02)	(0.01)
Monetary investment index	0.16	0.00	0.03*
	(0.20)	(0.03)	(0.02)
	Coefficient on		
	(1) Treat	(2) Treat × Mother's education	(3) Mother's education
Parenting style index	0.15	−0.01	0.05***
	(0.09)	(0.02)	(0.02)
Time investment index	0.16*	−0.00	0.02*
	(0.09)	(0.02)	(0.01)
Monetary investment index	0.16	0.00	0.03*
	(0.14)	(0.02)	(0.02)
	Coefficient on		
	(1) Treat	(2) Treat × Depression severity	(3) Depression severity
Parenting style index	0.14**	0.06	−0.10**
	(0.07)	(0.07)	(0.04)
Time investment index	0.16**	−0.03	−0.03
	(0.07)	(0.06)	(0.04)
Monetary investment index	0.17**	−0.10	0.02
	(0.08)	(0.08)	(0.07)
	Coefficient on		
	(1) Treat	(2) Treat × Mother's age	(3) Mother's age
Parenting style index	−0.23	0.01	−0.01
	(0.44)	(0.01)	(0.01)
Time investment index	0.34	−0.01	0.01
	(0.40)	(0.01)	(0.01)
Monetary investment index	−0.04	0.01	−0.01
	(0.48)	(0.01)	(0.01)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Index variables were created following Anderson (2008), with positive values always associated with positive outcomes for all indices. Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects as well as additional controls for baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared, and date of the interview.

D Appendix: Attrition

Table D.12 – Attrition corrected treatment effects: Inverse Probability Weights and Bounds

			All Baseline Controls		Lee Bounds CI	
	(1) Coeff (s.e.)	(2) FWER p-value	(3) Coeff (s.e.)	(4) FWER p-value	(5) Lower	(6) Upper
Cognitive development index	−0.04	0.79	−0.09	0.56	−0.37	0.20
	(0.09)		(0.08)			
Physical development index	0.08	0.61	0.07	0.56	−0.27	0.29
	(0.09)		(0.08)			
Socio-emotional development index	−0.10	0.46	−0.11	0.38	−0.45	0.12
	(0.08)		(0.08)			
			All Baseline Controls		Lee Bounds CI	
	(1) Coeff (s.e.)	(2) FWER p-value	(3) Coeff (s.e.)	(4) FWER p-value	(5) Lower	(6) Upper
Parenting style index	0.15*	0.09*	0.12*	0.09*	−0.06	0.48
	(0.08)		(0.06)			
Time investment index	0.18**	0.04**	0.15**	0.07*	0.05	0.59
	(0.07)		(0.07)			
Monetary investment index	0.22**	0.04**	0.17*	0.09*	−0.08	0.48
	(0.09)		(0.09)			

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Index variables were created following Anderson (2008), with positive values always associated with positive outcomes for all indices. Heteroskedasticity robust standard errors, clustered by Union Council, in parentheses. Columns 1-4 replicate the main results using IPW (Inverse Probability Weighting) to account for attrition. Column 1 report baseline effects controlling only for interview fixed effects. Column 3 includes additional controls for baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared, and interview date. Columns 2 and 4 calculate the p-values controlling for the family-wise error rate (FWER) using a free step-down resampling method. Columns 5 and 6 attrition bounds based on Lee (2009), using the starting sample of $N = 704$.

Table D.13 – Characteristics at Baseline, 6-month, & 1-year followups by LTFU (Attrition) Status

Sample Characteristics at THP Baseline:	(1) 7-year followup sample	(2) LTFU	(3) P-value
Mother's characteristics at baseline			
Mother's age	26.87	26.34	0.29
Mother's education	4.06	4.11	0.89
Mother's height (cm)	156.40	156.07	0.54
Mother's BMI	23.18	23.50	0.42
Mother's Mental Health at baseline			
Depression score (Hamilton)	14.49	14.97	0.24
Disability score (BDQ)	8.12	8.40	0.31
Perceived Social Support score (MSPSS)	46.01	42.38	0.02**
Family characteristics at baseline			
Joint/extended family structure	0.59	0.55	0.46
Grandmother lives with	0.50	0.49	0.84
No. member per room	3.64	3.79	0.33
Father's education	7.09	7.39	0.43
Father employed	0.90	0.90	1.00
Household income and SES at baseline			
log(Income)	4.25	3.46	0.01***
SES (1=Rich, 5=Poor)	3.59	3.71	0.24
Has debt	0.55	0.65	0.06*
Household assets at baseline			
Electricity	0.95	0.92	0.37
TV	0.61	0.55	0.24
Refrigerator	0.36	0.29	0.11
Bicycle	0.30	0.25	0.26
Car	0.07	0.03	0.05**
Flush toilet	0.27	0.29	0.67
Brick/concrete walls	0.87	0.90	0.33
Mother's outcomes at 6-month followup			
Mother depressed	0.36	0.37	0.89
Depression score (Hamilton)	6.31	6.31	1.00
Disability score (BDQ)	3.13	2.89	0.50
Perceived Social Support score (MSPSS)	47.75	45.31	0.12
Mother's outcomes at 1-year followup			
Mother depressed	0.42	0.41	0.90
Depression score (Hamilton)	7.84	8.15	0.69
Disability score (BDQ)	3.65	3.45	0.64
Perceived Social Support score (MSPSS)	47.06	46.15	0.51
Child weight (km)	8.19	8.25	0.61
Child height (cm)	72.09	72.05	0.92
Sample size	585	119	704

* $p < .10$, ** $p < .05$, *** $p < .01$

Note: The table shows sample means by attrition status (Column 1 shows the non-attritors, those found for the 2013 survey, and Column 2 shows the attriting women) for selected characteristics and outcomes measured at baseline, 6-month followup, and 1-year followup. Column 3 shows the p-value of the difference in means between attritors and non-attiritors.

Table D.14 – Characteristics at Baseline by Treatment Group (LTFU sample)

Sample Characteristics at THP Baseline:	(1) Treatment	(2) Control	(3) P-value
Mother's characteristics at baseline			
Mother's age	26.09	26.69	0.49
Mother's education	4.53	3.55	0.19
Mother's height (cm)	156.28	155.78	0.64
Mother's BMI	23.10	24.05	0.21
LTFU because moved	0.87	0.90	0.57
Mother's Mental Health at baseline			
Depression score (Hamilton)	14.88	15.08	0.79
Disability score (BDQ)	8.04	8.88	0.09*
Perceived Social Support score (MSPSS)	41.84	43.10	0.63
Family characteristics at baseline			
Joint/extended family structure	0.57	0.53	0.64
Grandmother lives with	0.54	0.41	0.16
No. member per room	3.87	3.69	0.51
Father's education	7.57	7.16	0.61
Father employed	0.87	0.94	0.19
Household income and SES at baseline			
log(Income)	3.77	3.04	0.13
SES (1=Rich, 5=Poor)	3.68	3.75	0.73
Has debt	0.68	0.60	0.40
Household assets at baseline			
Electricity	0.91	0.94	0.55
TV	0.62	0.47	0.11
Refrigerator	0.34	0.22	0.15
Bicycle	0.22	0.29	0.36
Water pump	0.38	0.24	0.09*
Car	0.03	0.02	0.74
Flush toilet	0.35	0.20	0.06*
Brick/concrete walls	0.93	0.86	0.26
Sample size	68	51	119

* $p < .10$, ** $p < .05$, *** $p < .01$

Note: The table shows sample means by Treated and Control groups for characteristics and outcomes measured at baseline for the LTFU mothers. Column 3 shows the p-value of the difference in means between the treated and control groups.

E Appendix: Index Components and Correlates

Table E.15 – Summary Statistics for Child Development Outcomes

	Mean	SD	Median	Minimum	Maximum	Total Obs
Cognitive development index[a]	0.03	1.03	0.16	-4.22	2.06	885
Full scale IQ	82.77	11.92	81.00	52.00	132.00	883
Urdu score	6.73	3.75	6.00	0.00	12.00	877
Math score	9.35	3.52	11.00	0.00	16.00	876
Executive function (Stroop)	14.15	3.11	16.00	0.00	16.00	885
Grade	1.93	0.87	2.00	0.00	3.00	873
Physical development index[a]	0.06	0.95	0.22	-4.74	1.95	885
Weight-for-age (z)	-1.14	1.12	-1.17	-4.75	4.31	883
Height-for-age (z)	-0.83	1.13	-0.82	-4.97	3.25	876
Motor function[b]	2.10	0.73	2.06	1.00	5.00	885
Hospitalization [b]	0.15	0.35	0.00	0.00	1.00	885
Severe illness [b]	0.27	0.44	0.00	0.00	1.00	885
Eyesight problems [b]	0.04	0.20	0.00	0.00	1.00	885
Hearing problems [b]	0.02	0.12	0.00	0.00	1.00	885
Socio-emotional development index[a]	0.03	0.97	0.11	-4.54	2.14	885
Behavioral issues (SDQ) [b]	11.00	5.21	10.00	0.00	28.00	885
Anxiety (Spence) [b]	20.05	13.06	18.00	0.00	90.00	885

Notes: Index variables, created such that the control group has mean 0, standard deviation 1, are in bold. The individual variables that make up each index are listed below. The sample includes the intervention (baseline depressed mothers in treatment and control groups) and non-intervention (baseline non-depressed mothers) groups.
[a] Index variables were created following Anderson (2008), with positive values always associated with positive outcomes for all indices.
[b] Higher value indicates unfavorable outcome. These outcomes were flipped in order to be included in the indices.

Table E.16 – Summary Statistics for Parenting Outcomes

	Mean	SD	Median	Minimum	Maximum	Total Obs
Parenting style index[a]	0.16	0.98	0.20	-3.04	3.85	885
Total PPI score [b]	37.49	12.52	37.00	3.00	77.00	885
HOME: responsivity	8.96	1.60	10.00	1.00	10.00	885
HOME: maturity	5.23	1.58	5.00	0.00	7.00	885
HOME: emotional climate	4.74	1.93	5.00	0.00	8.00	885
HOME: integration	2.82	0.97	3.00	0.00	12.00	885
Time investment index[a]	0.20	1.02	0.10	-1.95	2.67	885
HOME: enrichment	2.94	1.40	3.00	0.00	5.00	885
HOME: companionship	3.36	1.73	3.00	0.00	6.00	885
Frequency of mother play	0.77	1.35	0.00	0.00	4.00	885
Frequency of father play	0.72	1.22	0.00	0.00	4.00	829
Someone helps with studies	0.58	0.49	1.00	0.00	1.00	885
Monetary investment index[a]	0.16	1.04	0.22	-6.98	4.57	885
HOME: learning materials	2.86	1.54	3.00	0.00	6.00	885
HOME: physical environment	4.86	2.38	5.00	0.00	8.00	885
Education expenditures (100s PKR)	24.55	33.24	15.00	0.00	400.00	884
Expected grade attainment	14.45	2.45	16.00	0.00	21.00	881
Private school	0.47	0.50	0.00	0.00	1.00	878
Class size [b]	20.97	10.84	20.00	2.00	77.00	874
No. teachers in school	10.99	9.63	8.50	0.00	85.00	874
No. rooms in school	11.13	8.70	9.00	1.00	56.00	874
No. rooms in use	9.32	7.38	8.00	0.00	50.00	874
Classroom amenities	2.94	0.28	3.00	0.00	3.00	874
School amenities	6.00	2.09	6.00	1.00	9.00	874

Notes: Index variables, created such that the control group has mean 0, standard deviation 1, are in bold. The individual variables that make up each index are listed below. The sample includes the intervention (baseline depressed mothers in treatment and control groups) and non-intervention (baseline non-depressed mothers) groups.
[a] Index variables were created following Anderson (2008), with positive values always associated with positive outcomes for all indices.
[b] Higher value indicates unfavorable outcome. These outcomes were flipped in order to be included in the indices.

Table E.17 – Correlates of Child Development at Age 7 (Anderson index)

	Cognitive development index			Physical development index			Socio-emotional development index		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Girl	0.13	0.15	0.12	−0.06	−0.06	−0.10	−0.21	−0.18	−0.21
	(0.14)	(0.14)	(0.14)	(0.11)	(0.11)	(0.12)	(0.13)	(0.13)	(0.13)
Child age at interview	0.67*	0.71*	0.59	0.64	0.65	0.72	0.34	0.38	0.33
	(0.39)	(0.39)	(0.41)	(0.41)	(0.42)	(0.46)	(0.37)	(0.37)	(0.40)
Wealth score (at baseline)	0.05	0.05	0.05	0.04	0.04	0.02	0.00	−0.01	−0.03
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Mother's years of education	0.07***	0.06***	0.05***	−0.01	−0.01	−0.02	0.01	0.01	0.02
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Father's years of education	0.05***	0.05***	0.05***	0.00	0.00	0.00	0.04**	0.03**	0.03**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Mother's age	0.19***	0.19***	0.18***	0.15**	0.15**	0.14**	0.05	0.05	0.05
	(0.06)	(0.07)	(0.06)	(0.07)	(0.07)	(0.06)	(0.06)	(0.06)	(0.07)
Mother's age^2	−0.00***	−0.00***	−0.00***	−0.00**	−0.00**	−0.00**	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
No. kids (at baseline)	−0.09**	−0.09**	−0.09**	0.04	0.04	0.01	−0.01	0.00	−0.02
	(0.04)	(0.04)	(0.04)	(0.06)	(0.06)	(0.05)	(0.03)	(0.03)	(0.03)
Grandmother at baseline	0.06	0.03	−0.01	0.04	0.03	0.07	−0.02	−0.07	−0.12
	(0.07)	(0.07)	(0.06)	(0.11)	(0.11)	(0.14)	(0.12)	(0.13)	(0.14)
Mother depressed (at 7-year followup)		−0.26**	−0.21*		−0.07	0.03		−0.37**	−0.34**
		(0.11)	(0.12)		(0.16)	(0.16)		(0.14)	(0.12)
Baseline depression severity		0.02	0.04		−0.03	−0.03		−0.07	−0.03
		(0.07)	(0.07)		(0.07)	(0.08)		(0.05)	(0.05)
Mother play (at 1-year followup)			−0.02			0.05			−0.10
			(0.15)			(0.16)			(0.15)
Father play (at 1-year followup)			0.36***			0.16			0.02
			(0.08)			(0.15)			(0.14)
Diarrhea (at 1-year followup)			−0.31***			0.01			−0.18
			(0.10)			(0.17)			(0.11)
Breastfeeding (at 6-month followup)			0.02			−0.22			0.09
			(0.11)			(0.23)			(0.12)
ARI (at 1-year followup)			−0.05			−0.30**			−0.10
			(0.10)			(0.13)			(0.09)
Observations	292	292	274	292	292	274	292	292	274
R^2	0.24	0.25	0.31	0.08	0.08	0.12	0.13	0.16	0.19

* p < 0.1, ** p < 0.05, *** p < 0.01.

Notes: This table shows associations of child development with potential mediating infant inputs and key demographic and socioeconomic characteristics (which were used as controls in the main analysis). The sample consists only of mothers in the control group. Column 1 shows the associations by regressing the child development outcome on baseline demographic/socioeconomic characteristics. Column 2 adds mother's depressed status at the 7-year followup and her baseline depression severity. Column 3 adds mediating infant inputs and infant health. The child development indicators are measured using three broad domains and calculated as a summary index following Anderson (2008). All regressions control for interviewer fixed effects. Heteroskedasticity robust standard errors are clustered at the Union Council level.

Table E.18 – Correlates of Parental Behavior at Age 7 (Anderson index)

	Parenting style index			Time investment index			Monetary investment index		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Girl	0.01	0.04	0.04	−0.01	0.01	0.04	−0.21**	−0.20**	−0.17*
	(0.11)	(0.11)	(0.08)	(0.11)	(0.11)	(0.09)	(0.09)	(0.09)	(0.09)
Child age at interview	0.14	0.19	0.25	−0.06	−0.04	0.05	−0.04	0.01	−0.03
	(0.43)	(0.40)	(0.38)	(0.23)	(0.23)	(0.21)	(0.49)	(0.50)	(0.52)
Wealth score (at baseline)	0.04*	0.03	0.05*	0.07***	0.06**	0.08***	0.05*	0.05*	0.07**
	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Mother's years of education	0.07***	0.06***	0.05**	0.04***	0.04***	0.02	0.05***	0.05***	0.05**
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Father's years of education	0.03	0.02	0.02	0.04***	0.04***	0.02**	0.04***	0.04***	0.04**
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Mother's age	0.08	0.09	0.05	0.09	0.09	0.02	0.06	0.06	0.04
	(0.07)	(0.07)	(0.06)	(0.05)	(0.05)	(0.06)	(0.06)	(0.05)	(0.05)
Mother's age^2	−0.00	−0.00	−0.00	−0.00	−0.00	0.00	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
No. kids (at baseline)	0.01	0.02	0.05	−0.01	−0.01	−0.00	−0.03	−0.02	0.01
	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)	(0.02)	(0.05)	(0.06)	(0.05)
Grandmother at baseline	−0.01	−0.07	−0.13	0.05	0.03	−0.04	0.09	0.06	0.02
	(0.11)	(0.11)	(0.13)	(0.09)	(0.09)	(0.08)	(0.12)	(0.11)	(0.13)
Mother depressed (at 7-year followup)		−0.45***	−0.31**		−0.19	−0.01		−0.29**	−0.29**
		(0.10)	(0.12)		(0.11)	(0.07)		(0.11)	(0.11)
Baseline depression severity		−0.07	−0.02		−0.01	0.02		0.03	0.07
		(0.05)	(0.06)		(0.05)	(0.04)		(0.07)	(0.06)
Mother play (at 1-year followup)			0.57***			0.59***			0.02
			(0.14)			(0.09)			(0.14)
Father play (at 1-year followup)			0.27*			0.67***			0.21
			(0.14)			(0.11)			(0.14)
Diarrhea (at 1-year followup)			−0.20*			−0.09			−0.13
			(0.11)			(0.08)			(0.13)
Breastfeeding (at 6-month followup)			0.09			0.12			0.21
			(0.12)			(0.12)			(0.17)
ARI (at 1-year followup)			−0.02			−0.02			0.16
			(0.09)			(0.08)			(0.11)
Observations	292	292	274	292	292	274	292	292	274
R^2	0.25	0.30	0.39	0.50	0.51	0.70	0.19	0.20	0.22

* p $<$ 0.1, ** p $<$ 0.05, *** p $<$ 0.01.

Notes: This table shows associations of parenting behavior with potential mediating infant inputs and key demographic and socioeconomic characteristics (which were used as controls in the main analysis). The sample consists only of mothers in the control group. Column 1 shows the associations by regressing the child development outcome on baseline demographic/socioeconomic characteristics. Column 2 adds mother's depressed status at the 7-year followup and her baseline depression severity. Column 3 adds mediating infant inputs and infant health. The parental behavior indicators are measured using three broad domains and calculated as a summary index following Anderson (2008). All regressions control for interviewer fixed effects. Heteroskedasticity robust standard errors are clustered at the Union Council level.

F Appendix: Treatment effects within indices

Table F.19 – Child Cognitive Development index

		Treatment effects: full sample			By Gender	
	(1) Control Mean (st.dev.)	(2) Coeff β/(s.e.)	(3) FWER p-value	(4) N	(5) Girls	(6) Boys
WPPSI Full Scale IQ	82.13	−0.04	1.00	584	1.20	−1.11
	(11.40)	(0.94)			(1.28)	(1.28)
Urdu score	6.40	−0.07	0.99	580	−0.08	−0.27
	(3.52)	(0.26)			(0.33)	(0.45)
Math score	9.09	0.00	1.00	579	0.35	−0.37
	(3.58)	(0.29)			(0.34)	(0.46)
Executive function (Stroop)	14.19	−0.15	0.94	585	−0.25	−0.02
	(3.06)	(0.24)			(0.40)	(0.34)
Grade	1.95	−0.12	0.44	575	−0.25**	−0.01
	(0.84)	(0.08)			(0.10)	(0.11)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects as well as additional controls for baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton, BDQ, MSPSS scores and their squares, and date of the interview. Column 3 calculates the p-values controlling for the family-wise error rate (FWER) using a free step-down resampling method.

Table F.20 – Child Physical Development index

		Treatment effects: full sample			By Gender	
	(1) Control Mean (st.dev.)	(2) Coeff β/(s.e.)	(3) FWER p-value	(4) N	(5) Girls	(6) Boys
Weight-for-age (z)	−1.04	−0.10	0.70	583	−0.10	−0.08
	(1.18)	(0.08)			(0.12)	(0.11)
Height-for-age (z)	−0.77	−0.03	0.89	578	−0.01	−0.09
	(1.17)	(0.08)			(0.12)	(0.13)
Motor function	−2.07	−0.05	0.71	585	0.04	−0.10
	(0.70)	(0.05)			(0.09)	(0.06)
No hospitalization	−0.19	0.07*	0.38	585	0.07	0.07
	(0.39)	(0.04)			(0.04)	(0.05)
No severe illness	−0.31	0.04	0.70	585	0.03	0.04
	(0.46)	(0.03)			(0.05)	(0.04)
No eyesight problems	−0.05	0.00	0.89	585	−0.02	0.02
	(0.23)	(0.02)			(0.02)	(0.03)
No hearing problems	−0.02	0.02	0.70	585	0.02	0.02
	(0.15)	(0.01)			(0.02)	(0.02)

* p < 0.1, ** p < 0.05, *** p < 0.01.

Notes: Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects as well as additional controls for baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton, BDQ, MSPSS scores and their squares, and date of the interview. Column 3 calculates the p-values controlling for the family-wise error rate (FWER) using a free step-down resampling method.

Table F.21 – Child Socio-emotional Development index

		Treatment effects: full sample			By Gender	
	(1) Control Mean (st.dev.)	(2) Coeff β/(s.e.)	(3) FWER p-value	(4) N	(5) Girls	(6) Boys
SDQ: no behavioral problems	−11.12	−0.24	0.49	585	0.44	−1.15*
	(5.23)	(0.34)			(0.54)	(0.64)
Spence: no anxiety problems	−20.36	−1.80	0.18	585	−0.33	−2.87*
	(13.35)	(1.09)			(1.52)	(1.42)

* p < 0.1, ** p < 0.05, *** p < 0.01.

Notes: Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects as well as additional controls for baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton, BDQ, MSPSS scores and their squares, and date of the interview. Column 3 calculates the p-values controlling for the family-wise error rate (FWER) using a free step-down resampling method.

Table F.22 – Parenting Style index

		Treatment effects: full sample			By Gender	
	(1) Control Mean (st.dev.)	(2) Coeff β/(s.e.)	(3) FWER p-value	(4) N	(5) Girls	(6) Boys
Parenting practices inventory	−38.32	0.83	0.51	585	2.60*	−1.41
	(12.62)	(0.92)			(1.43)	(1.07)
Responsivity	8.76	0.20**	0.18	585	0.57***	−0.24
	(1.75)	(0.10)			(0.14)	(0.16)
Encouragement of maturity	5.24	−0.14	0.51	585	−0.04	−0.33
	(1.56)	(0.11)			(0.15)	(0.19)
Emotional climate	4.53	0.18	0.51	585	0.61**	−0.32
	(1.93)	(0.18)			(0.24)	(0.23)
Family integration	2.62	0.15**	0.11	585	0.16	0.12
	(0.92)	(0.06)			(0.10)	(0.10)

* p < 0.1, ** p < 0.05, *** p < 0.01.

Notes: Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects as well as additional controls for baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton, BDQ, MSPSS scores and their squares, and date of the interview. Column 3 calculates the p-values controlling for the family-wise error rate (FWER) using a free step-down resampling method.

Table F.23 – Parental Time-Intensive Investment index

		Treatment effects: full sample			By Gender	
	(1) Control Mean (st.dev.)	(2) Coeff β/(s.e.)	(3) FWER p-value	(4) N	(5) Girls	(6) Boys
Enrichment	2.66	0.26**	0.17	585	0.37**	0.20
	(1.40)	(0.13)			(0.15)	(0.18)
Family companionship	2.95	0.36***	0.02**	585	0.62***	0.11
	(1.77)	(0.12)			(0.16)	(0.21)
Frequency of mother play	0.68	−0.04	0.81	585	−0.02	−0.07
	(1.25)	(0.07)			(0.10)	(0.08)
Frequency of father play	0.62	0.02	0.86	550	−0.10	0.08
	(1.17)	(0.12)			(0.14)	(0.12)
Someone helps with studies	0.53	0.06*	0.23	585	0.04	0.05
	(0.50)	(0.03)			(0.05)	(0.05)

* p < 0.1, ** p < 0.05, *** p < 0.01.

Notes: Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects as well as additional controls for baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton, BDQ, MSPSS scores and their squares, and date of the interview. Column 3 calculates the p-values controlling for the family-wise error rate (FWER) using a free step-down resampling method.

Table F.24 – Parental Monetary-Intensive Investment index

		Treatment effects: full sample			By Gender	
	(1) Control Mean (st.dev.)	(2) Coeff β/(s.e.)	(3) FWER p-value	(4) N	(5) Girls	(6) Boys
Learning materials	2.67	0.22*	0.29	585	0.22	0.23
	(1.50)	(0.12)			(0.17)	(0.14)
Physical environment	4.67	0.11	0.70	585	0.33*	−0.11
	(2.39)	(0.14)			(0.18)	(0.24)
Education expend.(100s PKR)	21.87	5.69**	0.16	584	7.45**	5.17
	(27.65)	(2.39)			(3.22)	(4.19)
Expected grade attainment	14.07	0.37*	0.29	583	0.78***	0.00
	(2.73)	(0.19)			(0.28)	(0.22)
Private school	0.39	0.12**	0.16	580	0.16**	0.10
	(0.49)	(0.05)			(0.06)	(0.07)
Class size	−20.13	−1.39	0.64	576	−1.42	−1.46
	(10.78)	(1.28)			(1.36)	(1.84)
No. teachers in school	9.29	2.27***	0.08*	576	2.90***	1.69*
	(6.77)	(0.82)			(1.00)	(0.99)
No. rooms in school	9.72	1.67**	0.20	576	2.27**	1.02
	(7.15)	(0.78)			(0.94)	(0.96)
No. rooms in use	8.14	1.44**	0.22	576	1.66**	1.13
	(5.96)	(0.69)			(0.77)	(0.89)
Classroom amenities	2.94	−0.02	0.70	576	−0.05	0.01
	(0.26)	(0.03)			(0.03)	(0.04)
School Quality	5.62	0.53**	0.16	576	0.89***	0.12
	(2.05)	(0.22)			(0.30)	(0.26)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects as well as additional controls for baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton, BDQ, MSPSS scores and their squares, and date of the interview. Column 3 calculates the p-values controlling for the family-wise error rate (FWER) using a free step-down resampling method.

G Appendix: Treatment effects within subscales

Table G.25 – Treatment effects within subcomponents: HOME inventory

		Treatment effects: full sample			By Gender	
	(1) Control Mean (st.dev.)	(2) Coeff β/(s.e.)	(3) FWER p-value	(4) N	(5) Girls	(6) Boys
HOME inventory	34.11	1.34**	0.03**	585	2.84***	−0.33
	(9.05)	(0.58)			(0.88)	(0.92)
Responsivity	8.76	0.20**	0.22	585	0.57***	−0.24
	(1.75)	(0.10)			(0.14)	(0.16)
Encouragement of maturity	5.24	−0.14	0.50	585	−0.04	−0.33
	(1.56)	(0.11)			(0.15)	(0.19)
Emotional climate	4.53	0.18	0.52	585	0.61**	−0.32
	(1.93)	(0.18)			(0.24)	(0.23)
Learning materials	2.67	0.22*	0.27	585	0.22	0.23
	(1.50)	(0.12)			(0.17)	(0.14)
Enrichment	2.66	0.26**	0.22	585	0.37**	0.20
	(1.40)	(0.13)			(0.15)	(0.18)
Family companionship	2.95	0.36***	0.03**	585	0.62***	0.11
	(1.77)	(0.12)			(0.16)	(0.21)
Family integration	2.62	0.15**	0.13	585	0.16	0.12
	(0.92)	(0.06)			(0.10)	(0.10)
Physical environment	4.67	0.11	0.52	585	0.33*	−0.11
	(2.39)	(0.14)			(0.18)	(0.24)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Notes: Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects as well as additional controls for baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared, and date of the interview.

Table G.26 – Treatment effects within subcomponents: School quality

		Treatment effects: full sample			By Gender	
	(1) Control Mean (st.dev.)	(2) Coeff β/(s.e.)	(3) FWER p-value	(4) N	(5) Girls	(6) Boys
School Quality	5.62	0.53**	0.02**	576	0.89***	0.12
	(2.05)	(0.22)			(0.30)	(0.26)
School has office	0.77	0.05	0.51	576	0.14**	−0.03
	(0.42)	(0.04)			(0.07)	(0.04)
School has playground	0.81	0.07*	0.39	576	0.07	0.06
	(0.39)	(0.04)			(0.05)	(0.05)
School has library	0.39	0.09*	0.39	576	0.15**	0.01
	(0.49)	(0.05)			(0.07)	(0.07)
Library books visably in use	0.36	0.09*	0.39	576	0.16**	0.02
	(0.48)	(0.05)			(0.07)	(0.07)
School has water source	0.89	0.02	0.79	576	0.05	−0.01
	(0.32)	(0.04)			(0.04)	(0.04)
School has clean drinking water	0.92	−0.01	0.88	576	0.05	−0.06
	(0.26)	(0.03)			(0.04)	(0.04)
School has fencing	0.97	0.02	0.51	576	0.03	0.00
	(0.16)	(0.01)			(0.02)	(0.02)
School has computers	0.26	0.10**	0.16	576	0.12*	0.07
	(0.44)	(0.04)			(0.06)	(0.06)
Computersvisably in use	0.24	0.10**	0.19	576	0.13**	0.06
	(0.43)	(0.04)			(0.06)	(0.06)

* p < 0.1, ** p < 0.05, *** p < 0.01.

Notes: Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects as well as additional controls for baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared, and date of the interview.

Table G.27 – Treatment effects within subcomponents: WPPSI

		Treatment effects: full sample			By Gender	
	(1) Control Mean (st.dev.)	(2) Coeff β/(s.e.)	(3) FWER p-value	(4) N	(5) Girls	(6) Boys
WPPSI Full Scale IQ	82.13	−0.04	0.97	584	1.20	−1.11
	(11.40)	(0.94)			(1.28)	(1.28)
Verbal comprehension	85.24	0.10	0.94	583	0.93	−0.49
	(13.62)	(1.26)			(1.63)	(1.47)
Visual spatial	87.54	−1.68	0.39	584	−0.56	−2.29
	(15.04)	(1.10)			(1.63)	(1.54)
Fluid reasoning	77.67	0.24	0.94	584	1.93	−0.84
	(11.57)	(0.78)			(1.16)	(1.57)
Working memory	99.81	−1.09	0.76	584	−0.11	−1.69
	(15.59)	(1.32)			(1.94)	(1.50)
Processing speed	76.51	1.66**	0.15	581	2.66**	−0.06
	(9.58)	(0.77)			(1.14)	(0.97)

* p < 0.1, ** p < 0.05, *** p < 0.01.

Notes: Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects as well as additional controls for baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared, and date of the interview.

Table G.28 – Treatment effects within subcomponents: Spence Child Anxiety Score

		Treatment effects: full sample			By Gender	
	(1) Control Mean (st.dev.)	(2) Coeff β/(s.e.)	(3) FWER p-value	(4) N	(5) Girls	(6) Boys
Spence Child Anxiety Scale	20.36	1.80	0.11	585	0.33	2.87*
	(13.35)	(1.09)			(1.52)	(1.42)
Panic and agoraphobia	1.49	0.41*	0.28	585	0.31	0.52
	(2.68)	(0.23)			(0.33)	(0.34)
Separation	5.90	0.45	0.45	585	−0.11	0.94*
	(4.01)	(0.33)			(0.45)	(0.47)
Injury fear	6.01	0.12	0.87	585	0.02	0.01
	(3.67)	(0.29)			(0.39)	(0.33)
Social phobia	2.40	−0.11	0.87	585	−0.65*	0.42
	(2.94)	(0.23)			(0.38)	(0.34)
Obsessive-compulsive	1.20	0.58***	0.02**	585	0.78***	0.28
	(1.94)	(0.19)			(0.23)	(0.30)
General anxiety	3.37	0.33	0.48	585	−0.01	0.68*
	(3.27)	(0.27)			(0.35)	(0.38)

* p < 0.1, ** p < 0.05, *** p < 0.01.

Notes: Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects as well as additional controls for baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared, and date of the interview.

Table G.29 – Treatment effects within subcomponents: Strengths and Difficulties Questionnaire

		Treatment effects: full sample			By Gender	
	(1) Control Mean (st.dev.)	(2) Coeff β/(s.e.)	(3) FWER p-value	(4) N	(5) Girls	(6) Boys
SDQ Total Score	11.12	0.24	0.49	585	−0.44	1.15*
	(5.23)	(0.34)			(0.54)	(0.64)
Emotional	2.35	0.14	0.82	585	−0.05	0.36
	(2.05)	(0.14)			(0.23)	(0.22)
Conduct problems	3.31	−0.04	0.96	585	−0.54**	0.56**
	(2.04)	(0.16)			(0.20)	(0.24)
Hyperactivity	3.52	0.10	0.96	585	0.10	0.23
	(2.56)	(0.17)			(0.28)	(0.30)
Peer problems	1.94	0.04	0.96	585	0.04	−0.00
	(1.55)	(0.11)			(0.16)	(0.17)
Prosocial	7.50	0.08	0.96	585	0.24	−0.16
	(2.52)	(0.17)			(0.19)	(0.27)

* p < 0.1, ** p < 0.05, *** p < 0.01.

Notes: Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects as well as additional controls for baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared, and date of the interview.

H Appendix: Factor analysis

Table H.30 – Child development outcomes by broad domains (Factor)

			All Baseline Controls	
	(1) Coeff (s.e.)	(2) FWER p-value	(3) Coeff (s.e.)	(4) FWER p-value
Cognitive development index	0.02	0.86	−0.04	0.77
	(0.10)		(0.08)	
Physical development index	−0.06	0.68	−0.05	0.77
	(0.08)		(0.08)	
Socio-emotional development index	−0.11	0.50	−0.11	0.39
	(0.08)		(0.08)	

* p < 0.1, ** p < 0.05, *** p < 0.01.

Notes: Three index variables were created using factor analysis, with positive values always associated with positive outcomes for all indices. Heteroskedasticity robust standard errors, clustered by Union Council, in parentheses. Column 1 only includes controls for interviewer fixed effects. Column 3 reports treatment effects controlling for interview fixed effects, and baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared, and interview date.

Table H.31 – Child development: Difference-in-difference (Factor)

	Coefficient on		
	(1) Treat	(2) Treat × Prenatally Depressed	(3) Prenatally Depressed
Cognitive development index	−0.00	−0.04	0.04
	(0.13)	(0.14)	(0.09)
Physical development index	−0.13	0.05	0.08
	(0.12)	(0.16)	(0.09)
Socio-emotional development index	0.06	−0.19	−0.17*
	(0.11)	(0.11)	(0.09)

* p < 0.1, ** p < 0.05, *** p < 0.01.

Notes: Sample includes children of mothers who were depressed at baseline as well those who were not depressed at baseline, in both treatment and control clusters. Index variables were created with factor analysis, with positive values always associated with positive outcomes for all indices. Heteroskedasticity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects, age of mother and its square, father's and mother's education, parity, and the date of interview.

Table H.32 – Parenting outcomes by broad domains (Factor)

			All Baseline Controls	
	(1) Coeff (s.e.)	(2) FWER p-value	(3) Coeff (s.e.)	(4) FWER p-value
Parenting style index	0.11	0.15	0.09	0.22
	(0.07)		(0.06)	
Time investment index	0.16**	0.03**	0.14**	0.10*
	(0.06)		(0.07)	
Monetary investment index	0.29**	0.02**	0.27**	0.05*
	(0.11)		(0.11)	

* p < 0.1, ** p < 0.05, *** p < 0.01.

Notes: Three index variables were created using factor analysis, with positive values always associated with positive outcomes for all indices. Heteroskedasticity robust standard errors, clustered by Union Council, in parentheses. Column 1 only includes controls for interviewer fixed effects. Column 3 reports treatment effects controlling for interview fixed effects, and baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared, and interview date.

Table H.33 – Parenting behavior: Difference-in-difference (Factor)

	Coefficient on		
	(1) Treat	(2) Treat × Prenatally Depressed	(3) Prenatally Depressed
Parenting style index	−0.08	0.16	−0.07
	(0.12)	(0.13)	(0.10)
Time investment index	−0.08	0.21*	−0.16**
	(0.10)	(0.12)	(0.07)
Monetary investment index	0.26	−0.02	−0.07
	(0.17)	(0.17)	(0.10)

* p < 0.1, ** p < 0.05, *** p < 0.01.

Notes: Sample includes children of mothers who were depressed at baseline as well those who were not depressed at baseline, in both treatment and control clusters. Index variables were created with factor analysis, with positive values always associated with positive outcomes for all indices. Heteroskedasticity robust standard errors, clustered by Union Council, in parentheses. All regressions control for interviewer fixed effects, age of mother and its square, father's and mother's education, parity, and the date of interview.

Table H.34 – Treatment effects at 7 years: IPW (Factor)

			All Baseline Controls		Lee Bounds CI	
	(1) Coeff (s.e.)	(2) FWER p-value	(3) Coeff (s.e.)	(4) FWER p-value	(5) Lower	(6) Upper
Cognitive development index	0.00	0.86	−0.06	0.77	−0.32	0.25
	(0.11)		(0.08)			
Physical development index	−0.06	0.68	−0.05	0.77	−0.33	0.20
	(0.08)		(0.07)			
Socio-emotional development index	−0.10	0.47	−0.11	0.42	−0.45	0.13
	(0.08)		(0.08)			
Parenting style index	0.11	0.16	0.08	0.18	−0.15	0.41
	(0.07)		(0.06)			
Time investment index	0.15**	0.03**	0.13*	0.08*	0.02	0.59
	(0.06)		(0.07)			
Monetary investment index	0.27**	0.03**	0.25**	0.05**	0.06	0.65
	(0.11)		(0.11)			

* p < 0.1, ** p < 0.05, *** p < 0.01.

Notes: Three index variables were created using factor analysis, with positive values always associated with positive outcomes for all indices. Heteroskedasticity robust standard errors, clustered by Union Council, in parentheses. Column 1 only includes controls for interviewer fixed effects. Column 3 reports treatment effects controlling for interview fixed effects, and baseline values of age, age-squared, family structure, presence of grandmother (mother or mother-in-law of depressed mother), mother's education, father's education, parity, log of HH income, PCA-weighted wealth index, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared, and interview date. For columns (1) and (3), observations are weighted inversely by the predicted probability of being observed at the 7-year followup based on baseline covariates. Attrition bound 95% confidence intervals following Lee (2009) are presented in columns (5) and (6).

Table H.35 – Correlates of Child Development at Age 7 (Factor)

	Cognitive development index			Physical development index			Socio-emotional development index		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Girl	0.09	0.10	0.09	0.01	0.03	−0.01	−0.20	−0.18	−0.21
	(0.13)	(0.13)	(0.13)	(0.11)	(0.12)	(0.11)	(0.13)	(0.13)	(0.13)
Child age at interview	0.78**	0.84***	0.62*	−0.14	−0.07	−0.10	0.36	0.40	0.34
	(0.30)	(0.29)	(0.32)	(0.42)	(0.42)	(0.42)	(0.37)	(0.37)	(0.40)
Wealth score (at baseline)	0.05	0.06	0.05	0.01	0.02	0.03	0.00	−0.01	−0.03
	(0.03)	(0.03)	(0.03)	(0.05)	(0.05)	(0.05)	(0.03)	(0.03)	(0.03)
Mother's years of education	0.08***	0.07***	0.06***	−0.01	−0.01	−0.00	0.01	0.01	0.02
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Father's years of education	0.05***	0.05***	0.05***	0.01	0.01	0.00	0.04**	0.03**	0.03**
	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Mother's age	0.22***	0.23***	0.22***	0.00	−0.00	0.02	0.05	0.06	0.05
	(0.07)	(0.08)	(0.07)	(0.09)	(0.09)	(0.08)	(0.06)	(0.06)	(0.07)
Mother's age^2	−0.00**	−0.00**	−0.00***	−0.00	−0.00	−0.00	−0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
No. kids (at baseline)	−0.07	−0.06	−0.06	0.08	0.08	0.11**	−0.01	0.00	−0.02
	(0.04)	(0.04)	(0.05)	(0.06)	(0.06)	(0.05)	(0.03)	(0.03)	(0.03)
Grandmother at baseline	0.13	0.09	0.07	−0.07	−0.10	−0.05	−0.02	−0.07	−0.12
	(0.09)	(0.09)	(0.08)	(0.13)	(0.12)	(0.14)	(0.12)	(0.13)	(0.14)
Mother depressed (at 7-year followup)		−0.35***	−0.30**		−0.34*	−0.30		−0.37**	−0.34**
		(0.10)	(0.12)		(0.18)	(0.18)		(0.14)	(0.12)
Baseline depression severity		0.03	0.05		0.09	0.08		−0.07	−0.03
		(0.06)	(0.06)		(0.06)	(0.06)		(0.05)	(0.05)
Mother play (at 1-year followup)			−0.02			−0.07			−0.10
			(0.14)			(0.16)			(0.14)
Father play (at 1-year followup)			0.33***			−0.04			0.02
			(0.11)			(0.14)			(0.14)
Diarrhea (at 1-year followup)			−0.27**			0.01			−0.18
			(0.11)			(0.15)			(0.11)
Breastfeeding (at 6-month followup)			−0.07			−0.24			0.08
			(0.09)			(0.16)			(0.12)
ARI (at 1-year followup)			−0.12			0.05			−0.09
			(0.12)			(0.14)			(0.09)
Observations	287	287	270	288	288	270	292	292	274
R^2	0.28	0.30	0.34	0.04	0.06	0.07	0.13	0.16	0.18

* p $<$ 0.1, ** p $<$ 0.05, *** p $<$ 0.01.

Notes: This table shows associations of child development with potential mediating infant inputs and key demographic and socioeconomic characteristics (which were used as controls in the main analysis). The sample consists only of mothers in the control group. Column 1 shows the associations by regressing the child development outcome on baseline demographic/socioeconomic characteristics. Column 2 adds mother's depressed status at the 7-year followup and her baseline depression severity. Column 3 adds mediating infant inputs and infant health. The child development indicators are measured using three broad domains and calculated using factor analysis. All regressions control for interviewer fixed effects. Heteroskedasticity robust standard errors are clustered at the Union Council level.

Table H.36 – Correlates of Parental Behavior at Age 7 (Factor)

	Parenting style index			Time investment index			Monetary investment index		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Girl	−0.07	−0.04	−0.04	−0.07	−0.06	−0.07	−0.20**	−0.18*	−0.12
	(0.12)	(0.11)	(0.08)	(0.10)	(0.10)	(0.06)	(0.09)	(0.09)	(0.07)
Child age at interview	−0.20	−0.14	−0.08	−0.08	−0.06	0.11	−0.35	−0.33	−0.38
	(0.34)	(0.31)	(0.27)	(0.24)	(0.23)	(0.14)	(0.33)	(0.37)	(0.38)
Wealth score (at baseline)	0.05*	0.03	0.05*	0.04*	0.04	0.05***	0.01	−0.01	0.02
	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Mother's years of education	0.06***	0.06***	0.04**	0.05***	0.05***	0.02*	0.06**	0.06**	0.05*
	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Father's years of education	0.03**	0.03**	0.02*	0.04***	0.04***	0.02***	0.03*	0.03	0.03*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
Mother's age	0.11*	0.12*	0.06	0.05	0.05	−0.01	−0.01	−0.01	−0.01
	(0.06)	(0.07)	(0.05)	(0.06)	(0.06)	(0.05)	(0.08)	(0.08)	(0.09)
Mother's age^2	−0.00	−0.00	−0.00	−0.00	−0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
No. kids (at baseline)	−0.00	0.01	0.04	−0.07**	−0.06**	−0.03*	−0.00	0.00	0.01
	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)	(0.02)	(0.04)	(0.04)	(0.05)
Grandmother at baseline	−0.08	−0.14	−0.21	0.12	0.10	−0.01	0.13	0.10	0.05
	(0.11)	(0.11)	(0.13)	(0.07)	(0.07)	(0.05)	(0.11)	(0.12)	(0.13)
Mother depressed (at 7-year followup)		−0.48***	−0.35***		−0.18	0.02		−0.23*	−0.32**
		(0.09)	(0.10)		(0.11)	(0.06)		(0.12)	(0.13)
Baseline depression severity		−0.05	−0.02		−0.01	0.01		−0.07	−0.08
		(0.06)	(0.06)		(0.05)	(0.03)		(0.07)	(0.06)
Mother play (at 1-year followup)			0.57***			0.82***			0.15
			(0.14)			(0.06)			(0.19)
Father play (at 1-year followup)			0.35**			0.65***			−0.13
			(0.13)			(0.06)			(0.22)
Diarrhea (at 1-year followup)			−0.18*			−0.14**			0.08
			(0.11)			(0.06)			(0.15)
Breastfeeding (at 6-month followup)			0.21			0.13			−0.05
			(0.15)			(0.09)			(0.22)
ARI (at 1-year followup)			−0.06			−0.05			0.16
			(0.09)			(0.07)			(0.11)
Observations	292	292	274	274	274	274	288	288	271
R^2	0.24	0.29	0.39	0.57	0.57	0.80	0.11	0.13	0.15

* p $<$ 0.1, ** p $<$ 0.05, *** p $<$ 0.01.

Notes: This table shows associations of parenting behavior with potential mediating infant inputs and key demographic and socioeconomic characteristics (which were used as controls in the main analysis). The sample consists only of mothers in the control group. Column 1 shows the associations by regressing the child development outcome on baseline demographic/socioeconomic characteristics. Column 2 adds mother's depressed status at the 7-year followup and her baseline depression severity. Column 3 adds mediating infant inputs and infant health. The parental behavior indicators are measured using three broad domains and calculated using factor analysis. All regressions control for interviewer fixed effects. Heteroskedasticity robust standard errors are clustered at the Union Council level.

Table H.37 – Correlations Between Indices

	Cognitive Development		Physical Development		Socio-emotional Development		Parenting Style		Parenting Time-Intensive		Parenting Money-Inten.
	(Anderson)	(Factor)	(Anderson)	(Factor)	(Anderson)	(Factor)	(Anderson)	(Factor)	(Anderson)	(Factor)	(Anderson)
Cognitive Development (Anderson)	1.00 885										
Cognitive Development (Factor)	0.89 868	1.00 868									
Physical Development (Anderson)	0.11 885	0.10 868	1.00 885								
Physical Development (Factor)	-0.02 876	-0.01 860	0.45 876	1.00 876							
Socio-emotional Development (Anderson)	0.18 885	0.21 868	0.11 885	-0.02 876	1.00 885						
Socio-emotional Development (Factor)	0.18 885	0.21 868	0.11 885	-0.02 876	0.99 885	1.00 885					
Parenting Style (Anderson)	0.23 885	0.25 868	-0.03 885	-0.05 876	0.29 885	0.29 885	1.00 885				
Parenting Style (Factor)	0.23 885	0.28 868	-0.02 885	-0.05 876	0.22 885	0.22 885	0.86 885	1.00 885			
Parenting Time (Anderson)	0.07 885	0.16 868	0.12 885	-0.02 876	0.09 885	0.09 885	0.31 885	0.41 885	1.00 885		
Parenting Time (Factor)	0.09 829	0.19 813	0.12 829	0.00 820	0.10 829	0.10 829	0.34 829	0.45 829	0.93 829	1.00 829	
Parenting Money (Anderson)	0.20 885	0.28 868	-0.01 885	-0.05 876	0.14 885	0.14 885	0.25 885	0.34 885	0.29 885	0.32 829	1.00 885
Parenting Money (Factor)	0.14 873	0.24 867	0.04 873	0.04 864	0.13 873	0.13 873	0.20 873	0.21 873	0.19 873	0.21 818	0.44 873

Notes: This table shows the pairwise correlations between index variables created in two ways: following Anderson (2009) and using factor scores. The number of observations is listed below the correlation coefficient. The Anderson procedure produces an index even individuals have missing values for certain components of the index, whereas the factor scores drop those observations.