

The Long-term Impact of Treating Maternal Depression: Evidence from a Randomized Controlled Trial in Pakistan

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Abstract

We evaluate the long-term impact of a Randomized Controlled Trial that provided psychotherapy for perinatally depressed mothers in rural Pakistan. This paper presents results from a 7 year follow-up of the Thinking Healthy Programme (THP), which provided Cognitive Behavioral Therapy (CBT) based treatment to clinically depressed mothers in their third trimester and lasted through 10 months postpartum in 2005-2006. The intervention was successful in the short-term, with a depression recovery rate 78% higher for treated mothers. The 7-year follow-up, successfully re-enrolled 83% of the THP sample, a strikingly low attrition rate given the timeframe. Our results suggest that mental health benefits persist even 7 years after the start of the intervention. At the time of the interview, treated mothers were 6 percentage points less likely to be depressed, they report 28% fewer number of depressive episodes in the intermediate period, and they perceive more social support. We find evidence of heterogeneous treatment effects, particularly for whether the grandmother of the index child was living with family at baseline and if the mother perceives a high level of social support. The beneficial effect of CBT appears to be concentrated among mothers who do not have a grandmother living with them or high levels of social support at baseline. This suggests that social support provides a buffer effect that enables recovery, for which treatment is a substitute.

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1 Introduction

Mental health is an important factor in human behavior. Defined broadly, it 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. With good mental health, individuals can tolerate reasonable amounts of pressure, adapt to changing circumstances, and work according to their abilities (WHO, 2005).¹ As such, mental health is closely related to non-cognitive skills and is considered an important input into the human capital production function Krishnan and

¹The WHO defines mental health as “as a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community.”

Krutikova (2013); Heckman et al. (2006); Currie and Stabile (2006); Currie (2009).² A number of studies explore the relationship between mental health and life outcomes. For example, Layard et al. (2014) find that the most powerful childhood predictor of adult life-satisfaction is the child's emotional health. Layard (2013) argues that mental health is a major factor of production, and, thus, the economic cost of mental illness is very high.

Although mental health appears to be an important factor for behavior and decision-making, few studies have been able to evaluate the causal impact on mental health. Issues of reverse causality are particularly salient, as sub-optimal behavior can lead to worse well-being. Further, because mental health is such a broad concept and is difficult to measure, finding credible instruments or natural experiments is especially difficult. Randomized interventions that provided psychological treatments are, in this case, ideally suited to answer the question.

This study evaluates the long-term impact of a Randomized Controlled Trial (RCT) that provided Cognitive Behavioral Therapy (CBT), a form of psychotherapy, to perinatally depressed mothers in Pakistan. The follow-up occurs 6 years after the intervention concludes, and is, to our knowledge, the only long-term follow-up of a randomized psychological intervention that also explores outcomes in economic decision-making.

Maternal depression around the time of childbirth is exceptionally common. Recent evidence suggests rates of common perinatal mental disorders (CPMDs) among women from low- and lower-middle-income countries, was found to be 15.6% in pregnant women and 19.8% in women who had recently given birth Rahman et al. (2013).³ Hospital based studies have found postnatal depression rates of 23 percent in Goa, India; 22 percent in eastern Turkey; and 15.8 percent in Dubai and a rural community based study in Pakistan found postnatal depression rates to be around 28 percent Rahman (2005). Studies in a literature documenting the associations of maternal depression on the psychological development of children have shown that maternal depression are adversely associated with a child's psychological development, intellectual competence, psychosocial function and rate of psychiatric morbidity Murray et al. (1996, 1999).

One particularly important factor of production that has been the focus of a broad literature in economics is the household production of children. Conti and Heckman (2014), in a summary of recent evidence on child well-being, explain how early childhood

²Some authors have proposed the term psychosocial competencies instead of non-cognitive skills, since these skills do require cognitive processes. Psychosocial competencies have been captured by measures of agency and self-efficacy, self-esteem, and aspirations Dercon and Krishnan (2009).

³In high income countries, those rates are 10% and 13% respectively Rahman et al. (2013).

environment is exceptionally predictive of outcomes as adults. Gaps in cognitive and personality traits that emerge very early in life and persist over time can explain differences in a number of adult outcomes.⁴⁵ The authors point out that dynamics of human development begin in the womb, laying the foundations of adult outcomes. Given the high prevalence of perinatal depression, particularly in poor and developing regions, and the importance of early childhood environment on adult outcomes, interventions aimed to improve maternal mental health could have extremely high economic value.⁶

Perinatal depression interventions have shown promising results in improving child outcomes in the short term, but given the cluster of risk factors often accompanying depression, it is not known whether treating depression in the perinatal period is sufficient to have long term impacts on child development trajectories. Randomized Control Trials (RCTs) of maternal mental health interventions that do report positive impacts on children tend to have short follow-up periods, typically lasting between 1-18 months. The few studies that have followed children for longer, e.g. 5 years post intervention, report that most, if not all, initial positive effects are no longer observed. The data is therefore inconclusive in regard to whether a maternal mental health intervention in the first year of life has only short term impacts on the child or whether it's possible for such an intervention to improve the child's overall developmental trajectory Murray et al. (2003); Kersten-Alvarez et al. (2010); Cicchetti et al. (2000); Van Doesum et al. (2008); Siegenthaler et al. (2012).

Our results suggest that mental health benefits persist 6 years after the original THP study was completed (which we refer to as the 7 year follow-up). At the time of the interview in 2013, treated mothers were 6 percentage points less likely to be depressed, they reported 28% fewer number of depressive episodes in the intermediate period, and they perceived more social support. We provide corrections for attrition following Lee (2009), which does not qualitatively alter our findings. However, due to the fact that perinatal depression tends to spontaneously resolve (indeed, 70% of the control mothers were no longer suffering from depression at the 7 year follow-up), implying that the analysis becomes somewhat under-powered over time. The point estimates border on

⁴The authors cite examples of the Perry Preschool Project and the Abecedarian project in the U.S. that show positive effects of early environment enrichment for disadvantaged children (at age 3 for Perry Preschool) on behavioral traits, school achievements and job performance.

⁵In another study, Carneiro et al. (2007) use data from National Child Development Survey in Great Britain to show that early home environment is an important determinant of non-cognitive skills.

⁶(This is also the Barker hypothesis. Though a critical difference is that home environment, particularly parental inputs, are not only effecting the child in womb, but thereafter as well.)

marginally significant, and the attrition bounds often fail to reject zero at the lower bound. Nevertheless, multiple pieces of evidence suggest that there are persistent effects of the treatment on maternal mental health.

Finally, we find evidence of heterogeneous treatment effects, particularly for whether the grandmother of the index child was living with family at baseline. The beneficial effect of CBT appears to be concentrated among mothers who do not have a grandmother living with them. We also find similar heterogeneous effects by baseline perceived social support: mother's who had less social support benefited more from the treatment. Mother's who reported having high levels of social support or grandparents present at baseline do not appear to benefit from treatment, though they are less likely to be depressed in 2013. Interesting, there is no evidence of heterogeneity by socioeconomic status. This suggests that social support provides a buffer effect that enables recovery, for which treatment is substitute.

The rest of the paper is organized as follows. Section 2 discusses the importance of studying mental health, particularly in developing countries. Section 3 describes the original THP intervention, and Section 4 describes the Saving Brains follow-up procedure. Section 5 describes the data and empirical strategy. Section 6 presents the main results, attrition analysis, and heterogeneous effects. Lastly, Section 7 concludes.

2 Mental Health in Developing Countries

Recent studies have found that mental health issues, most often depression and anxiety disorders, contribute to substantial productivity loss in the workplace. In many developed countries, 35-45% of absenteeism from work is due to mental health problems (World Health Organization, 2003a). In the United States, for example, 18.2% of employed people had evidence of a mental disorder which had impaired their work performance within the previous 30 days Kessler and Frank (1997). Ettner et al. (1997) show that psychiatric disorders reduce employment and earnings among both men and women. In developed countries, since mental health problems are more likely to afflict those of working age, currie1999health argue that the labor market consequences of mental health problems are large relative to the consequences of physical health problems.

Although mental health has gained a lot of attention in health policy discussions in developed countries, until recently it has largely been ignored in the developing world. In data from multiple countries, Das et al. (2009) show that poor mental health is associated with low labor force participation. A number of studies describe the potential for a mental

health poverty trap through the lens of public health Knapp et al. (2006); Lund et al. (2011). Patel and Kleinman (2003) use cross-national data for a meta analysis of the relationship between poverty and mental health. While these public health studies all suggest that mental health problems are even more severe in developing countries and that there is a possibility for a mental health poverty trap, these studies provide no causal evidence on how mental health impacts economic well-being. Moreover, they are unable to provide insights into the mechanisms by which poor mental health might create a poverty trap.

Meanwhile, development economics has primarily focused on poverty traps that result from extreme resource scarcity such as nutrition and income, particularly in the face of credit and insurance constraints. While some behavior can be explained by “purely economic” constraints, a large part of the persistence of poverty remains unexplained even after accounting for resource constraints. This has lead economists to consider more psychologically driven reasons for underinvestment and “irrational” behavior, such as hyperbolic discounting. However, even augmenting resource constraints with insights from behavioral economics fall short of describing the patterns of behavior. Recently, development economists conjecture that poor mental health may create a poverty trap (Banerjee and Duflo (2007) and Case and Deaton (2005) and Haushofer and Fehr (2013). Poverty, in addition to being a state of resource constraint, may be amplified by additional psychological constraints that are triggered when resources are scarce. Indeed, the literature on scarcity describes one particular way in which psychological constraints are amplified when resources are scarce.

Although mental health may be an important factor in economic decision-making, little research has been done to provide causal evidence on the effect of mental health on decision-making outside of the laboratory setting. Most of the attention on mental health has been in developed countries and measures of mental health have recently become available in longitudinal studies in developed countries (such as the NLSY, the German Socio-Economic Panel, and the Household Income and Labour Dynamics in Australia Survey). However, data on mental health in longitudinal studies are extremely rare in developing countries, making it even more difficult to study the relationship between poverty, mental health, and decision-making. Even when mental health measures are available, determining the impact of mental health on decision-making remains challenging due to simultaneity, reverse causality, measurement error, and network effects.

3 The Intervention: Thinking Healthy Programme in Pakistan

The Thinking Healthy Programme THP was a cluster randomized community trial of a perinatal depression intervention in rural Pakistan. 20 Union Council administrative units (clusters) 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 significant illness) who met DSM-IV-TR 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.

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 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 called Thinking Healthy Programme (THP) used cognitive behavior therapy techniques of active listening, collaboration with the family, guided discovery to treat perinatal depression of pregnant mothers in 20 randomly selected Union Councils (smallest administrative units) out of 40 in two rural areas of Pakistan in 2005. Village based community health workers were trained to provide this enhanced care with routine practice of maternal and child health education. Mother and child dyads in both the treatment and control groups were re-interviewed 6 months and 12 months postnatally.

Rahman et al. (2008a) describe the intervention in detail and report the findings of the THP intervention on perinatal depression of women and on nutritional and health outcomes of infants. 463 mothers received this THP intervention program, 440 mothers were in the control group and after 1 year 412 treated mothers & 386 mothers in the control group were analyzed in a follow-up study. Further, 360 infants in the treated group and 345 infants in the control group were analyzed at 1 year. They find that

the intervention did not bring a significant change in the growth of the infants but the infants of treated mothers were more likely to have completed immunization and had less episodes of diarrhea. Mothers in the treated group were more likely to use contraception and both parents in the treated group reported spending more time playing with their infants. Further, they find that women receiving this intervention had less disability and better social functioning which were sustained after one year.

All mothers were evaluated by a psychiatrist at baseline, 6 month follow-up and 1 year follow-up to determine if they were experiencing a major depressive episode (MDE). At baseline, all mothers were depressed. Nearly 80 percent of treated mothers were not depressed during the THP 6 month follow-up compared to 48 percent mothers in the control group. Similarly 75 percent of treated mothers were not depressed during the THP 1 year follow-up compared to 42 percent mothers in the control group. These differences are statistically significant at the 1 percent level and indicate that the intervention was effective in reducing the presence of depression Rahman et al. (2008a). Note, however, that there is a very high rate of spontaneous recovery among perinatally depressed mothers.

4 The follow-up: Saving Brains

There had been no additional data collection or follow-up with the women since 2007 when the children were 12 months old. In 2013, when the children were 7 years old, a follow-up study called Saving Brains (SB) was initiated in order to assess the children's developmental outcomes.

As a first step the follow-up study extracted a list of all the women with their contact information from the original trial and re-contacted them. Five field supervisors, who were blind to the woman's depression or trial status, worked directly with the LHWs to relocate and re-enroll study participants. Additional queries with neighbors or relatives, as well as local hospital record checks, also assisted in locating the women. Fieldwork, lasted between March 2013 and January 2014 with a field team of 7 assessors. Each dyad interview consisted of two parts: the first in the woman's home and the second either in the child's school or in the LHW's house, which is a commonly used meeting place. The purpose of the second session was to administer the cognitive function tests to the child in a quiet and more standardized environment than the home. This paper will focus primarily on the mother's outcomes.

Using these methods the follow-up study successfully located and re-enrolled 83% (n=584) of women and their children who were last interviewed in 2007, with 85.5%

(n=295) of the control group dyads and 80.3% (n=289) of the intervention arm dyads. The follow-up study also enrolled 300 mother-child dyads prenatally non-depressed women. Because of limited data available about women who screened out of the original THP study (3,242 prenatally non-depressed), the follow-up study used each trial participant's village, neighborhood and LHW assignment to identify a prenatally non-depressed woman to contact for re-enrollment. Although a full follow-up interview was completed by the non-depressed sample, baseline (2006) characteristics are not available. Nevertheless, this sample allows for an additional analysis that also compares depressed to non-depressed mothers.

5 Empirical Analysis

5.1 Data

Our empirical analysis focuses on the 2013 SB sample, incorporating the information from the THP study. That means, for the sample of mother-and-child dyad that were located and interviewed at the 7 year follow-up (which is 83% of the sample at the 1-year following post THP intervention)⁷ we have data from baseline (2005), the 6-month follow-up (2006), the 1-year follow-up (2007). Our analysis will only include data from baseline (as controls) and the 7-year follow-up, though we will present some information from the 6-month and 1-year follow-ups as background.

At each interview, the mothers were evaluated for clinical depression, per the DSM-IV-TR diagnostic criteria. Figure 1 plots the fraction of mothers who satisfy criteria for a Major Depressive Episode (MDE) at each instance they were interviewed, split by treatment group. There is a very high level of spontaneous resolution over time for maternal depression, as only 30% of control mothers were depressed by 2013.⁸ Nevertheless, it's clear that the treated groups were less likely to be depressed in the short-run in response to the intervention, by a difference of 31 percentage points by the 1-year follow-up. Depression among mothers in the treated group was still less likely by 2013, but only by a difference of 6 percentage points, though that difference is not statistically significant. However, because of spontaneous resolution, differences between treated and control groups will become more difficult to detect, statistically. Therefore, we present additional tests that explore other types of data.

In 2013, mothers were also asked to recall incidents of past depressive episodes, for

⁷We will also include a discussion of the full intervention attrition, beginning the baseline in 2005.

⁸This is consistent with the medical literature (CITES).

which onset and offset dates were collected for each episode that occurred between the 1-year follow-up and the 7-year follow-up. This allows us to calculate whether a mother was depressed in a given year between clinical measurements. We also use the number of episodes and total duration of episodes since the 1-year follow-up in 2007 as alternative measures of depression severity.

Figure 2 plots the fraction of mothers who satisfy criteria for a Major Depressive Episode (MDE) based on recall. We only plot data beginning 2008, but include in 2013 both recalled and measured instances of maternal depression.⁹ It is quite clear that the recall data is of substantially poorer quality than the measured depression at the time of interviews. It appears that mothers are substantially underreporting depression in the recall, especially so going back to 2008 and 2009. This is, at the very least, consistent with recall being more difficult with time. However, a very clear pattern emerges that treated women were less likely to recall being depressed in the intervening period between interviews. Moreover, the difference between treated and control women’s depression rates appears to be constant over time and consistent with the difference in the measured depression in 2013.

5.2 Econometric Specifications

Given that treatment assignment was random, the main identification strategy is straightforward. Our principal estimating equation for impacts on outcome measures is

$$Y_{ic} = \alpha + \beta T_c + \mathbf{\Gamma}' \mathbf{X}_{ic} + \varepsilon_{ic} \quad (5.1)$$

where Y_{ic} is the depression outcome for the mother, i , in 2013. T_c is a dummy equal to one if the mother is in the treated group, which by the cluster design varies only at the Union Council level, c . \mathbf{X}_{ic} is a vector of controls. All specification include interviewer fixed effects. Additional controls will be baseline (lagged) values of depression measures, as well as baseline demographic characteristics. Standard errors are clustered at the Union Council level, the unit of randomization.

In addition to the above specification, we will also estimate a second model using the perinatally non-depressed mothers. For these mothers, we have 2013 values but do not

⁹This primarily is driven by the measured value of depression, since the recall depression would have had to have been completed by the time of the interview for it to be counted in the recall module.

have baseline data. The estimating equation is

$$Y_{ic} = \alpha + \eta T_c \times Depressed_{ic} + \beta T_c + \delta Depressed_{ic} + \mathbf{\Gamma}' \mathbf{X}_{ic} + \varepsilon_{ic} \quad (5.2)$$

where $Depressed_{ic}$ is a dummy that equals one if the mother was in the perinatally depressed group. 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. Alternative specifications we run will include Union Council (UC) fixed effects.¹⁰ The benefit of this approach is to ensure that our results are not driven spuriously by chance if some of the UCs received shocks unrelated to treatment in the period after the 1-year follow-up. Because there are only 20 UCs in each intervention arm and a long time delay after the initial balancing tests were completed at baseline, this is concern. This specification is akin to the a difference-in-difference analysis.

5.3 Balancing and Attrition

Appendix Table 10 the balancing for the 2013 sample with baseline characteristics. The table shows that the sample, at baseline, appears to be fairly well balanced (though this includes the effect of attrition). Appendix Table 10 shows few notable differences between treatment groups: treated women at baseline 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) living with them, they perceive higher levels of social support, and are less likely to have a home with brick or concrete walls.

Appendix Table 11 replicates Appendix Table 10, but using the Full THP sample (that is, those who were lost to follow-up in 2013). Similar patterns emerge, notably that grandmother present is still significantly different by treatment group. Further, mothers are slightly more educated and more likely to have a washing machine (a significant difference at 5%).

The difference between Appendix Tables 10 and 11 is due to attrition, and at first glance does not appear to be strongly differential between treatment group. Treated mothers were slightly more likely to attrit than controls mothers (19 vs 15%) but the difference is not statistically significant at conventional levels. Table 2 confirms that LTFU (attritors) and mothers that were re-enrolled were fairly similar along characteristics.

¹⁰Standard errors are clustered at the Union Council level for all specifications.

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). We will use 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.

Table ?? shows baseline characteristics of the LTFU women by treatment group. Confirming the finding between Tables 10 and 11, there were no differences between treated and control LTFU mothers at the 5% significance level.

6 Results

6.1 Main results

4 Table 1 shows the sample characteristics in 2013 for perinatally depressed women. Since these are characteristics post-intervention, apart from demographics, these characteristics are all possibly affected by treatment. In 2013, treated mothers report to be significantly younger and more educated than control mothers. The age difference, however, is not present at baseline *with the same sample of women*. Mother's mental health outcomes are obviously affected by treatment. Additionally, there appears to be a statistically significant difference in family composition, particularly that the grandmother lives with family. There is also a significant difference between the socioeconomic status (SES) index, reported by the Lady Health Worker. The SES index appears to change in response to treatment, as LHWs possibly report happier mothers to have a better SES. This is supported by the fact that at baseline, SES was uncorrelated with treatment group, and the correlation appeared only after mothers received treatment. Further, other measures of SES such as household income, father's education and employment, and household assets are orthogonal at baseline.

Table 4 presents the main results for the impact of the intervention on maternal depression, estimated using the specification in equation (5.1). Panel A presents the most parsimonious results, controlling only for interviewer fixed effects. Panel B includes 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, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared (including baseline SES doesn't alter the results, but we omit them for the main specifications).

Column 1 uses maternal depression as measured by psychiatrist in 2013 as the de-

pendent variable. The outcome measure in Column 2 is whether the mother was ever depressed post-intervention (between 2008-2013) according to both recall data and the measured depression in 2013. Column 3 just uses recall data to calculate if mother reported being depressed between interviews. Column 4 looks at treatment on the total number of depressive episodes the mother reported between 2008-2013, including both recall and measured. The outcome in Column 5 is the total duration of depressive episodes (which is recall data only).

Outcomes for columns 6 and 7 are calculated as follows. Using only measured depression data, a mother was coded as permanently recovered if she was not clinically depressed at the 1-year follow-up or the 7-year follow-up. A mother was coded as never recovered if she was depressed at both 1-year and 7-year follow-ups. Finally, Column 8 presents the effect of treatment on the perceived social support score (MSPSS score). Unfortunately, the SB follow-up did not collect any other mental health scales that were collected during the THP study.¹¹

Table 4 provides statistically weak evidence of the impact of treatment on maternal depression in 2013. The recalled depressive episodes and number of intervening episodes show that treated mothers were 4 percentage points less likely to report being depressed between surveys compared to control, and report 30% fewer number of episodes, both marginally significant (at 10%). Columns 6 and 7 show that treated mothers were 24 percentage points more likely to recover permanently, and 13 percentage points less likely to have never recovered. Both results are highly significant, though it's not surprising as they do incorporate the information for 1-year follow-up. Lastly, treated mothers reported a significantly higher MSPSS score.¹²

Table 4 Panel B shows that the point estimates are quite stable after controlling for a battery of baseline characteristics (described earlier), suggesting that any baseline differences remaining after randomization are not spuriously driving the results.

Table 5 shows the results under the second specification, which incorporates the data from the 300 perinatally non-depressed mothers. Because we only have data in 2013 for the non-depressed sample, we can only control for age, age-squared, mother's education, father's education, and parity. Additionally, we cannot look at permanent recovery. The

¹¹The THP study collected the Hamilton Depression score, the Brief Disability Questionnaire, and the MSPSS score in all rounds. These measures are still used as baseline controls for the severity of maternal depression.

¹²The fact that the recall results are more statistically significant is consistent with the fact that the study loses power over time because of the spontaneous recovery of perinatally depressed mothers.

coefficient on the interaction term $\text{Baseline depressed} \times \text{Treated}$ is the parameter of interest. Panel A controls for the available baseline demographics, and Panel B additionally controls for UC fixed effects (not possible to do in the first specification, obviously, since that's the level of randomization). The results are very similar to those presented in Table 4. Panel B confirms that diverging trends at the UC level are not spuriously driving the results.

6.1.1 Attrition

Due to long delay between interview rounds, it is somewhat striking that interviewers were able to re-enroll 83% of the THP sample. Nevertheless, attrition rates were not identical by treatment group, which could result in biased estimates. In Table 6, we provide bounds of the main results following Lee (2009). Panel A reproduces the OLS estimates from Panel A of 4 for convenience. Panel B calculated the bounds for the treatment effect without controls, and Panel C controls for baseline variables of grandmother present, a binary indicator of wealth (based on Lady Health Worker SES), and a binary indicator for perceived social support (based on MSPSS being greater than the mean of 45). The 95% confidence interval for the treatment effect is reported based on the bounds estimated in Panel B. Given the already statistically weak results, it's not surprising that 95% confidence interval from the ATE includes zero for all but the permanent recovery and never recovered outcomes. The bounds are still informative, however, and in Panel B the lower bound is statistically different from zero at the 10% level for columns 1-4. Including controls, however, moved the bounds closer to zero, indicating that the controls were not strongly predicting attrition.¹³

6.2 Heterogeneous Treatment Effects

A large literature suggests the recovery from perinatal depression is mediated by factor of social support (CITES). Additionally, it is very plausible that the effect of treatment varied by the severity of depression. In this section we explore the heterogeneous effects of treatment. Figures 3-5 plot three outcomes variables as a non-parametric function of depression severity (Hamilton score, left panel) and social support (MSPSS score, right panel) at baseline. The three outcomes are maternal depression in 2013 (3), whether the mother recovered permanently (4), and perceived social support in 2013 (5). The left panels of Figures 3 and 4 suggest that the intervention impacted mothers fairly evenly along the dimension of depression severity. On the other hand, the right panels suggest

¹³Show the actual binary variables used for the bound controls and attrition.

that mothers with low perceived social support at baseline benefitted more from the intervention. Figure 5 left panel, shows that more severely depressed mothers responded to intervention with more perceived social support in 2013 than less depressed mothers. However, the right panel shows no discernible difference of perceived support as a function of baseline perceived support.

Table 7 re-estimates the main impact regression separately for mothers with and without grandmothers present at baseline. The full baseline controls are included in all of the models for the heterogeneous effects analysis (although the results are unchanged for the parsimonious specification). Grandmotherless households at baseline fared worse overall throughout the program: they were 18 percentage points less likely to recover permanently. The results are consistent with public health literature on perinatal depression, indicating the treatment was extremely beneficial for mothers without grandmothers. The results for all outcomes are statistically significant at least at 5%. For mothers without grandmothers present at baseline, treatment reduced the likelihood of measured depression in 2013 by 9 percentage points! However, the recalled measures actually suggest that the intervention might have interfered with maternal recovery.

Table 8 re-estimates the main impact regression separately for mothers with high and low baseline levels of perceived support (high was defined as greater the mean/median MSPSS baseline score of 45). The results are quite similar to those in Table 7: mothers with low perceived social support at baseline fared worse overall, but the intervention improved their outcomes more. The point estimates for the impact of treatment for low MSPSS mothers are overall lower than the effect for mothers without grandmothers. However, the overall effects are in line with public health finding that social support is an important factor for recovery from perinatal depression.

Lastly, Table 9 re-estimates the main impact regression separately for mothers with high and low baseline SES scores. It would perhaps makes sense that socioeconomic factors might be important for the effectiveness of the intervention. However, our results do not support that hypothesis, and we find no evidence of heterogeneous effects by whether the mother was relative rich or poor. This also suggests that socio-emotional support is a more important factor for recovery from perinatal depression than income alone.

7 Conclusion

Although mental health may be an important factor in economic decision-making, little research has been done to provide causal evidence on the effect of mental health on decision-making outside of the laboratory setting. Despite mental health's potential importance for productivity and the persistence of poverty, no studies have, to our knowledge evaluated the long-term impact of mental health.

This paper evaluates the long-term impact of a Randomized Controlled Trial that provided psychotherapy for perinatally depressed mothers in rural Pakistan. This paper presents results from a 7 year follow-up of the Thinking Healthy Programme (THP), which provided Cognitive Behavioral Therapy (CBT) based treatment to clinically depressed mothers in their third trimester and lasted through 10 months postpartum in 2005-2006.

Our results suggest that mental health benefits persist even 7 years after the start of the intervention. At the time of the interview, treated mothers were 6 percentage points less likely to be depressed, they report 28% fewer number of depressive episodes in the intermediate period, and they perceive more social support.

We find evidence of heterogeneous treatment effects, particularly for whether the grandmother of the index child was living with family at baseline. The beneficial effect of CBT appears to be concentrated among mothers who do not have a grandmother living with them. We also find similar heterogeneous effects by baseline perceived social support: mother's who had less social support benefited more from the treatment. Mother's who reported having high levels of social support or grandparents present at baseline do not appear to benefit from treatment, though they are less likely to be depressed in 2013. Interesting, there is no evidence of heterogeneity by socioeconomic status. This suggests that social support provides a buffer effect that enables recovery, for which treatment is substitute. Public health policies offering psychological treatment for perinatal depression might be able to make better use of resources if treatment was targeted toward mothers without adequate social support.

Further research is needed to explore the endogenous response of individuals to mental health shocks, which responses are able to buffer against such shocks, and what circumstances enable an endogenous mitigation of mental health shock and what circumstances may leave individuals at risk. Moreover, the impact of mental health on economic decision-making, without endogenous shock-buffering, is still poorly understood.

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Figures and Tables

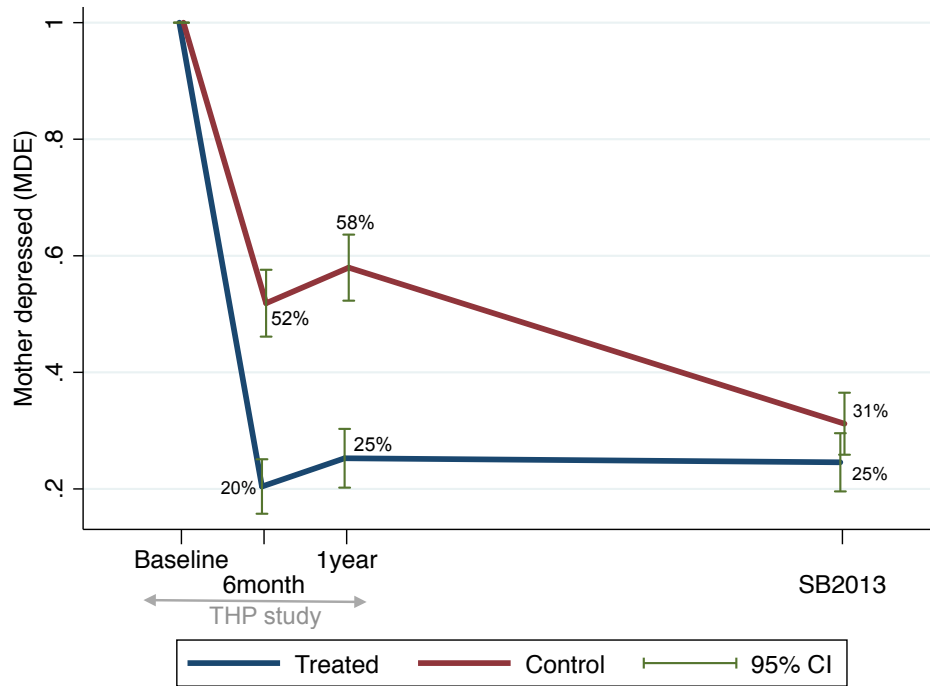
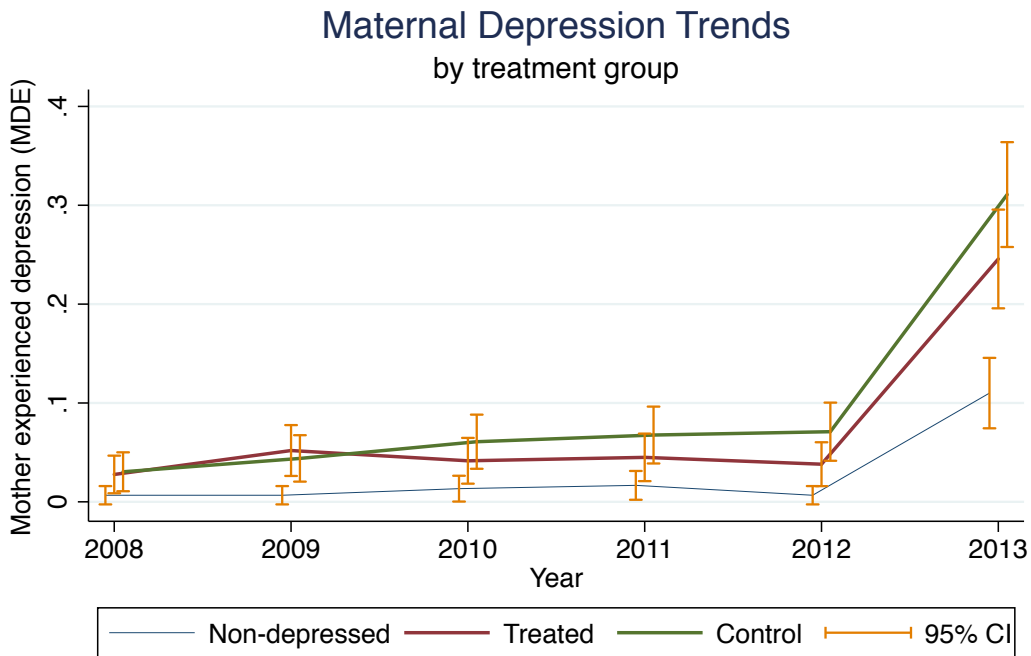


Figure 1 – Measured Depression Outcomes from THP Study and SB Follow-up



Note: Depression incidence calculated from recall data for years 2008-2013. 2013 includes measured MDE evaluated at survey interview (not recall).

Figure 2 – Depression trends by Treatment Group (with Baseline Non-depressed for comparison)

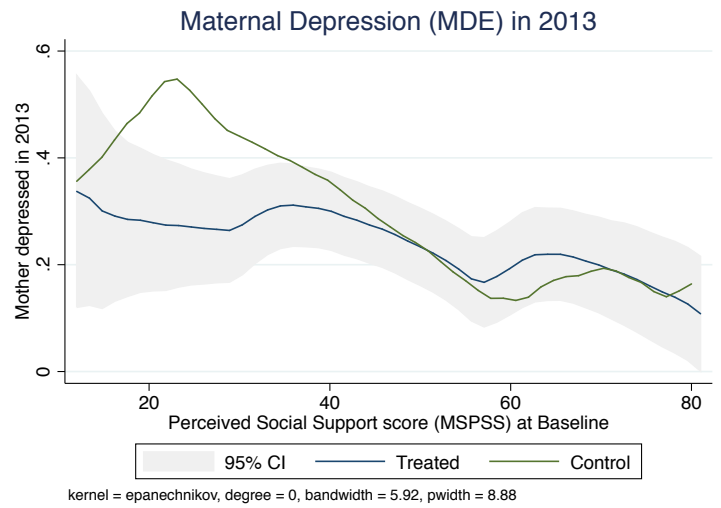
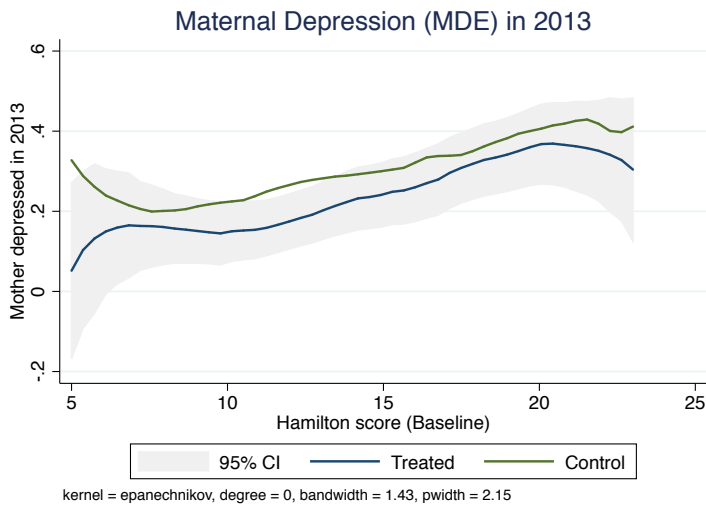


Figure 3 – Maternal Depression (MDE) in 2013 by Treatment Group

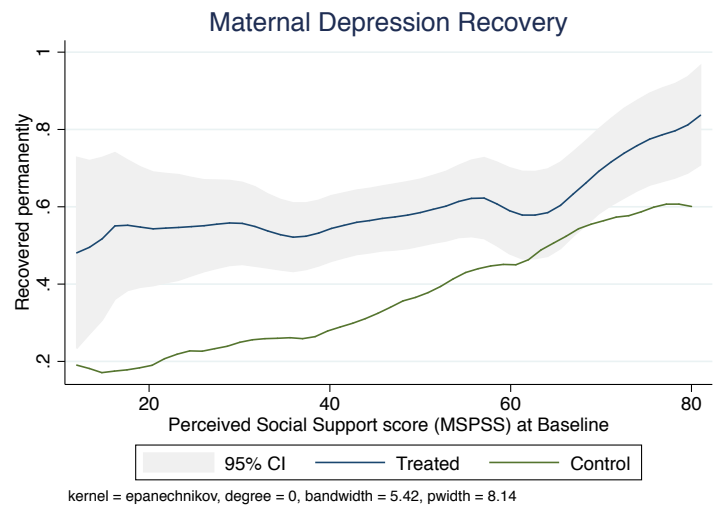
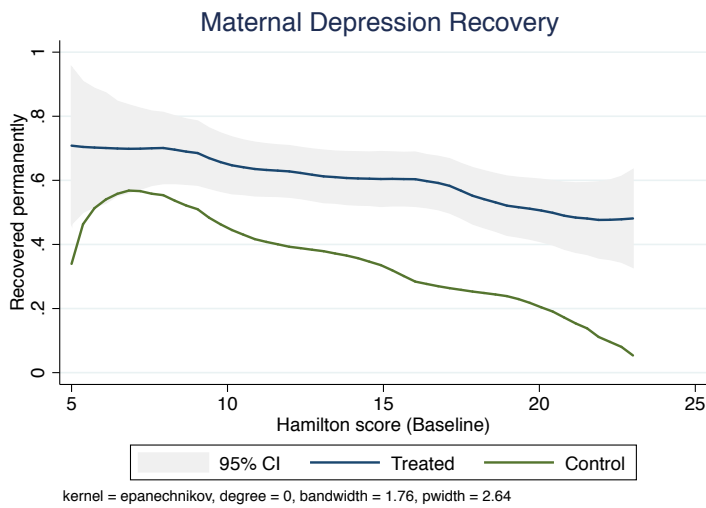


Figure 4 – Permanent recovery by 2013 by Treatment Group

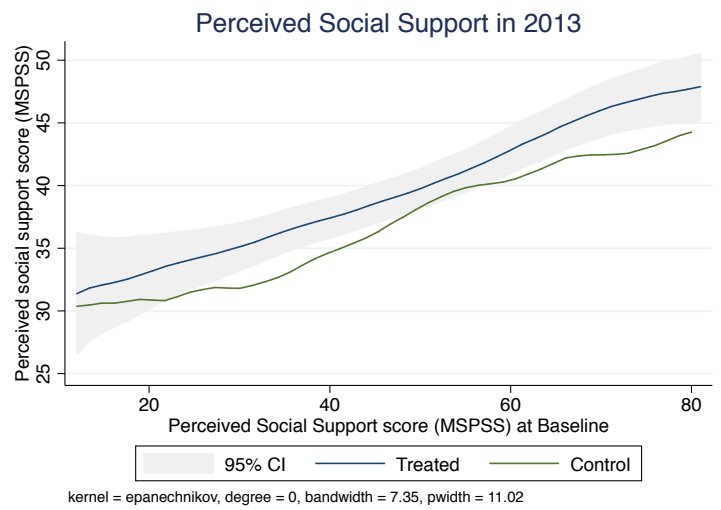
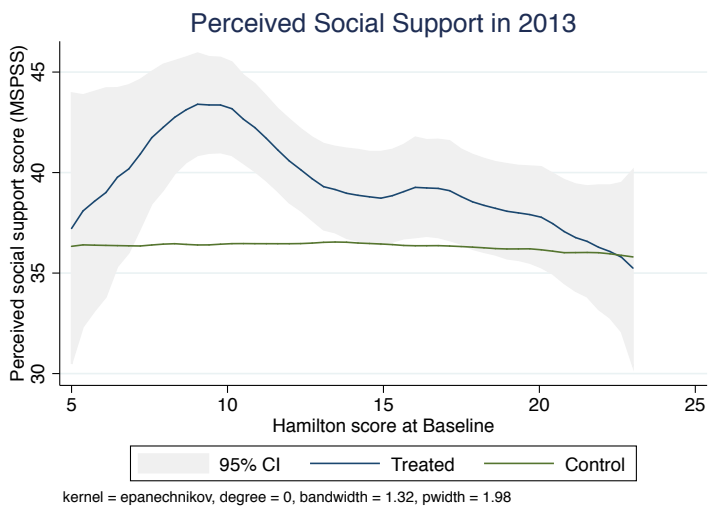


Figure 5 – Perceived social support (MSPSS) in 2013 by Treatment Group

Table 1 – Sample Characteristics in 2013 by Treatment Group

Sample Characteristics:	(1) Treated	(2) Control	(3) P-value
Mother's characteristics			
Mother's age	34.06	35.38	0.01***
Mother's education	4.34	3.70	0.05**
Number of kids	4.23	4.40	0.18
Number of kids born to mother in last 7 years	1.07	1.01	0.47
Avg age if kids born to mother in last 7 yrs	3.60	3.83	0.13
Mother's general health (1=vgood 5=vbad)	3.12	3.16	0.60
Mother's Mental Health			
Currently depressed (MDE)	0.24	0.30	0.11
Perceived social support score (MSPSS)	39.56	36.35	0.00***
Recovered permanently	0.60	0.34	0.00***
Never recovered	0.09	0.23	0.00***
Depressed ever between 2008-2013	0.28	0.35	0.08*
Depressed between 2008-2013 (recall only)	0.12	0.16	0.12
Number of recalled depressive episodes	0.15	0.21	0.13
Number of depressive episodes since 2007	0.34	0.46	0.07**
Duration of recalled depressive episodes (yrs)	0.12	0.15	0.43
Family characteristics			
Joint/extended family structure	0.56	0.48	0.04**
Grandmother lives with	0.42	0.31	0.01***
Number of adults living with	3.82	3.62	0.28
Father's characteristics			
Father's education	6.96	6.97	0.99
Father employed	0.87	0.87	0.91
Father's occupation non-manual worker	0.06	0.05	0.80
Household income and SES			
log(Income)	9.27	9.27	0.94
SES (1=Rich, 5=Poor)	3.42	3.54	0.05**
Has debt	0.65	0.62	0.43
Piped drinking water	0.09	0.08	0.81
Flush toilet	0.57	0.58	0.80
Outcomes at 1-year followup (2007)			
Mother depressed	0.25	0.58	0.00***
Hamilton score	5.04	10.59	0.00***
BDQ score	2.07	5.20	0.00***
Perceived Social Support score (MSPSS)	51.30	42.90	0.00***
SES (1=Rich, 5=Poor)	3.64	3.86	0.00***
Grandmother lives with	0.55	0.41	0.00***
Sample size	289	296	585

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

Note: The table shows sample means by Treated and Control groups for characteristics and outcomes measured in the 2013 follow-up. Column 3 shows the p-value of the difference in means between the treated and control groups.

Table 2 – Characteristics at Baseline, 6-month, & 1-year followups by LTFU (Attrition) Status

Sample Characteristics at THP Baseline:	(1) 2013 Sample	(2) LTFU	(3) P-value
Mother's characteristics			
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			
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			
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 characteristics			
Father's education	7.09	7.39	0.43
Father employed	0.90	0.90	1.00
Father's occupation non-manual worker	0.29	0.32	0.54
Household income and SES			
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 characteristics			
Electricity	0.95	0.92	0.37
Radio	0.49	0.41	0.13
TV	0.61	0.55	0.24
Refrigerator	0.36	0.29	0.11
Bicycle	0.30	0.25	0.26
Air con	0.05	0.03	0.34
Washing machine	0.28	0.25	0.53
Water pump	0.40	0.32	0.09*
Car	0.07	0.03	0.05**
Piped drinking water	0.07	0.07	0.98
Flush toilet	0.27	0.29	0.67
Brick/concrete walls	0.87	0.90	0.33
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
SES (1=Rich, 5=Poor)	3.71	3.96	0.00***
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
SES (1=Rich, 5=Poor)	3.75	3.85	0.23
Grandmother lives with	0.48	0.34	0.00***
Child weight (kg)	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-attriters, those found for the 2013

Table 3 – Characteristics at Baseline by Treatment Group (LTFU sample)

Sample Characteristics at THP Baseline:	(1) Treated	(2) Control	(3) P-value
Mother's characteristics			
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			
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			
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 characteristics			
Father's education	7.57	7.16	0.61
Father employed	0.87	0.94	0.19
Father's occupation non-manual worker	0.33	0.31	0.87
Household income and SES			
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 characteristics			
Electricity	0.91	0.94	0.55
Radio	0.40	0.43	0.71
TV	0.62	0.47	0.11
Refrigerator	0.34	0.22	0.15
Bicycle	0.22	0.29	0.36
Air con	0.01	0.06	0.19
Washing machine	0.29	0.20	0.23
Water pump	0.38	0.24	0.09*
Car	0.03	0.02	0.74
Piped drinking water	0.09	0.04	0.29
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.

Table 4 – Effect of Treatment on Maternal Mental Health Outcomes

Dependent variable:	Currently dep. (MDE) (1)	Dep. ever btw 2008-13 (2)	Dep 2008-13 (recall only) (3)	# of MDEs recall & curr (4)	Duration of MDEs (yrs) (5)	Recovered permanently (6)	Never recovered (7)	MSPSS score (8)
<i>Panel A: Main results</i>								
Treated	-0.046 (0.03)	-0.059 (0.04)	-0.043* (0.02)	-0.063* (0.03)	-0.020 (0.03)	0.24*** (0.05)	-0.13*** (0.03)	3.10*** (1.1)
R-squared	0.097	0.11	0.17	0.16	0.11	0.095	0.082	0.092
<i>Panel B: With full baseline controls</i>								
Treated	-0.036 (0.03)	-0.049 (0.03)	-0.040* (0.02)	-0.060* (0.03)	-0.013 (0.02)	0.22*** (0.04)	-0.12*** (0.03)	2.52** (1.0)
R-squared	0.16	0.17	0.19	0.18	0.12	0.19	0.14	0.25
Mean of dep. var	0.27	0.31	0.14	0.18	0.14	0.47	0.16	37.9
Observations	585	585	585	585	585	585	585	585

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

Note: Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All models are OLS and include interviewer fixed effects. Panel B includes 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, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared (including baseline SES doesn't alter the results).

Table 5 – Effect of Treatment on Maternal Mental Health Outcomes: Alternative specification using Baseline Non-depressed Mothers

Dependent variable:	Currently dep. (MDE) (1)	Dep. ever btw 2008-13 (2)	Dep 2008-13 (recall only) (3)	# of MDEs recall & curr (4)	Duration of MDEs (yrs) (5)	MSPSS score (6)
<i>Panel A: Without UC Fixed Effects</i>						
Baseline depressed × Treated	-0.029 (0.05)	-0.068 (0.06)	-0.077** (0.04)	-0.095* (0.05)	-0.053 (0.04)	2.89* (1.6)
Treated	-0.0080 (0.04)	0.015 (0.04)	0.038 (0.03)	0.037 (0.03)	0.035 (0.02)	0.036 (1.3)
Baseline depressed	0.14*** (0.04)	0.18*** (0.04)	0.13*** (0.02)	0.18*** (0.03)	0.12*** (0.03)	-3.75*** (1.2)
R-squared	0.13	0.14	0.15	0.15	0.10	0.18
<i>Panel B: With UC Fixed Effects</i>						
Baseline depressed × Treated	-0.024 (0.05)	-0.062 (0.06)	-0.077** (0.04)	-0.090* (0.05)	-0.055 (0.04)	3.04* (1.6)
Treated	0.25* (0.1)	0.065 (0.2)	-0.013 (0.10)	0.084 (0.08)	0.049 (0.06)	-0.75 (5.2)
Baseline depressed	0.14*** (0.04)	0.18*** (0.04)	0.13*** (0.02)	0.17*** (0.03)	0.12*** (0.03)	-3.76*** (1.2)
R-squared	0.17	0.18	0.18	0.18	0.14	0.24
Mean of dep. var	0.22	0.25	0.10	0.13	0.100	39.2
Observations	877	877	877	877	877	877

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

Note: Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All models are OLS and include interviewer fixed effects. Panel B includes controls for baseline values of age, age-squared, mother's education, father's education, and parity.

Table 6 – Effect of Treatment on Maternal Mental Health Outcomes: Attrition Bounds

Dependent variable:	Currently dep. (MDE) (1)	Dep. ever btw 2008-13 (2)	Dep 2008-13 (recall only) (3)	# of MDEs recall & curr (4)	Duration of MDEs (yrs) (5)	Recovered permanently (6)	Never recovered (7)	MSPSS score (8)
<i>Panel A: OLS Estimates</i>								
Treated	-0.046 (0.03)	-0.059 (0.04)	-0.043* (0.02)	-0.063* (0.03)	-0.020 (0.03)	0.24*** (0.05)	-0.13*** (0.03)	3.10*** (1.1)
Observations	585	585	585	585	585	585	585	585
<i>Panel B: Without controls</i>								
Lower	-0.075* (0.04)	-0.086** (0.04)	-0.053* (0.03)	-0.072* (0.04)	-0.036 (0.04)	0.23*** (0.04)	-0.15*** (0.03)	1.90 (1.3)
Upper	-0.021 (0.05)	-0.033 (0.05)	0.00051 (0.04)	0.032 (0.05)	0.051 (0.04)	0.29*** (0.05)	-0.095** (0.04)	4.48*** (1.3)
<i>Panel C: With controls</i>								
Lower	-0.066 (0.04)	-0.073 (0.05)	-0.046 (0.03)	-0.061 (0.04)	-0.027 (0.04)	0.21*** (0.05)	-0.14*** (0.04)	1.72 (1.4)
Upper	-0.0100 (0.05)	-0.012 (0.05)	0.0083 (0.04)	0.013 (0.06)	0.042 (0.05)	0.27*** (0.06)	-0.087** (0.04)	3.95*** (1.4)
Observations	704	704	704	704	704	704	704	704
Mean of dep. var	0.27	0.31	0.14	0.18	0.14	0.47	0.16	37.9
95% CI for ATE	[-0.14, 0.05]	[-0.15, 0.04]	[-0.10, 0.07]	[-0.14, 0.11]	[-0.09, 0.12]	[0.16, 0.36]	[-0.20, -0.03]	[-0.22, 6.66]

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

Note: This table presents attrition-adjusted bounds for the treatment effect following Lee (2009). Trimming proportion for all estimates is 0.051. Panel A reproduces the basic unadjusted OLS estimates. Panel B presents the bounds without controls. Panel C includes controls for baseline variables of grandmother present, a binary indicator of wealth (based on Lady Health Worker SES), and a binary indicator for perceived social support (based on MSPSS being greater than the mean of 45). The 95% confidence interval for the treatment effect is reported based on the bounds estimated in Panel B.

Table 7 – Effect of Treatment on Maternal Mental Health Outcomes: Heterogeneous Effects by Grandmother present at baseline

Dependent variable:	Currently dep. (MDE) (1)	Dep. ever btw 2008-13 (2)	Dep 2008-13 (recall only) (3)	# of MDEs recall & curr (4)	Duration of MDEs (yrs) (5)	Recovered permanently (6)	Never recovered (7)	MSPSS score (8)
<i>Panel A: Grandmother present at baseline</i>								
Treated	0.021 (0.04)	0.054 (0.05)	0.057* (0.03)	0.073* (0.04)	0.094** (0.04)	0.16*** (0.05)	-0.038 (0.04)	1.02 (1.4)
Mean of dep. var	0.23	0.26	0.13	0.16	0.14	0.56	0.12	39.2
Observations	291	291	291	291	291	291	291	291
<i>Panel B: No grandmother present at baseline</i>								
Treated	-0.092** (0.04)	-0.14*** (0.04)	-0.12*** (0.03)	-0.17*** (0.05)	-0.100*** (0.03)	0.28*** (0.06)	-0.19*** (0.04)	3.40** (1.5)
Mean of dep. var	0.31	0.36	0.15	0.19	0.14	0.38	0.19	36.6
Observations	294	294	294	294	294	294	294	294

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

Note: Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All models are OLS and include interviewer fixed effects. 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, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared (including baseline SES doesn't alter the results). Panel A restricts the sample to mothers who have their mother or mother-in-law living with them at baseline. Panel B restricts the sample to mothers who don't.

Table 8 – Effect of Treatment on Maternal Mental Health Outcomes: Heterogeneous Effects by Perceived Social Support (MSPSS) at baseline

Dependent variable:	Currently dep. (MDE) (1)	Dep. ever btw 2008-13 (2)	Dep 2008-13 (recall only) (3)	# of MDEs recall & curr (4)	Duration of MDEs (yrs) (5)	Recovered permanently (6)	Never recovered (7)	MSPSS score (8)
<i>Panel A: High MSPSS at baseline</i>								
Treated	-0.021 (0.04)	-0.038 (0.04)	-0.027 (0.04)	-0.045 (0.05)	0.016 (0.04)	0.20*** (0.06)	-0.038 (0.04)	3.33*** (1.2)
Mean of dep. var	0.17	0.24	0.12	0.15	0.100	0.58	0.10	42.4
Observations	281	281	281	281	281	281	281	281
<i>Panel B: Low MSPSS at baseline</i>								
Treated	-0.079 (0.05)	-0.082* (0.05)	-0.052 (0.03)	-0.078* (0.05)	-0.047 (0.04)	0.25*** (0.05)	-0.19*** (0.05)	2.22 (1.4)
Mean of dep. var	0.36	0.38	0.16	0.21	0.17	0.37	0.21	33.8
Observations	304	304	304	304	304	304	304	304

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

Note: Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All models are OLS and include interviewer fixed effects. 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, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared (including baseline SES doesn't alter the results). Panel A restricts the sample to mothers with high perceived social support at baseline (MSPSS score greater than 45). Panel B restricts the sample to mothers with low perceived social support.

Table 9 – Effect of Treatment on Maternal Mental Health Outcomes: Heterogeneous Effects by SES at baseline

Dependent variable:	Currently dep. (MDE) (1)	Dep. ever btw 2008-13 (2)	Dep 2008-13 (recall only) (3)	# of MDEs recall & curr (4)	Duration of MDEs (yrs) (5)	Recovered permanently (6)	Never recovered (7)	MSPSS score (8)
<i>Panel A: High SES at baseline</i>								
Treated	-0.046 (0.04)	-0.048 (0.05)	-0.022 (0.03)	-0.016 (0.04)	0.017 (0.03)	0.25*** (0.06)	-0.10*** (0.04)	3.04** (1.3)
Mean of dep. var	0.23	0.27	0.11	0.14	0.095	0.56	0.13	40.4
Observations	292	292	292	292	292	292	292	292
<i>Panel B: Low SES at baseline</i>								
Treated	-0.065 (0.06)	-0.077 (0.05)	-0.053 (0.04)	-0.12* (0.06)	-0.041 (0.05)	0.24*** (0.06)	-0.15** (0.06)	1.61 (1.3)
Mean of dep. var	0.31	0.36	0.17	0.22	0.18	0.38	0.19	35.4
Observations	293	293	293	293	293	293	293	293

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

Note: Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All models are OLS and include interviewer fixed effects. 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, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared (including baseline SES doesn't alter the results). Panel A restricts the sample to households labeled as relatively rich at baseline by the Lady Health Workers, and Panel B restricts the sample to relatively poor.

Appendix: For Online Publication

Table 10 – Baseline Characteristics by Treatment Group (2013 sample)

Sample Characteristics at THP Baseline:	(1) Treated	(2) Control	(3) P-value
Mother's characteristics			
Mother's age	26.66	27.07	0.31
Mother's education	4.31	3.81	0.12
Parity	3.16	3.38	0.11
Mother's height (cm)	156.63	156.17	0.31
Mother's BMI	23.31	23.05	0.45
Mother's Mental Health			
Depression score (Hamilton)	14.74	14.24	0.14
Disability score (BDQ)	8.08	8.17	0.72
Perceived Social Support score (MSPSS)	47.45	44.61	0.04**
Family characteristics			
Joint/extended family structure	0.62	0.56	0.13
Grandmother lives with	0.55	0.44	0.01***
No. member per room	3.54	3.74	0.11
Father's characteristics			
Father's education	6.96	7.21	0.43
Father employed	0.90	0.90	0.88
Father's occupation non-manual worker	0.28	0.30	0.76
Household income and SES			
log(Income)	4.29	4.21	0.75
SES (1=Rich, 5=Poor)	3.55	3.63	0.32
Has debt	0.56	0.55	0.67
Household characteristics			
Electricity	0.96	0.93	0.08*
Radio	0.51	0.47	0.31
TV	0.62	0.61	0.85
Refrigerator	0.39	0.33	0.11
Bicycle	0.31	0.30	0.85
Air con	0.07	0.04	0.13
Washing machine	0.31	0.25	0.07*
Water pump	0.43	0.38	0.24
Car	0.08	0.07	0.81
Piped drinking water	0.07	0.06	0.57
Flush toilet	0.28	0.26	0.58
Brick/concrete walls	0.84	0.90	0.04**
Sample size	289	296	585

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

Note: The table shows sample means by Treated and Control groups for characteristics measured at baseline for the sample of women used in the analysis (those found in the 2013 follow-up). Column 3 shows the p-value of the difference in means between the treated and control groups.

Table 11 – Characteristics at Baseline by Treatment Group (Full THP sample)

Sample Characteristics at THP Baseline:	(1) Treated	(2) Control	(3) P-value
Mother's characteristics			
LTFU	0.19	0.15	0.12
Mother's age	26.55	27.02	0.21
Mother's education	4.35	3.77	0.05**
Parity	3.16	3.38	0.11
Mother's height (cm)	156.57	156.12	0.28
Mother's BMI	23.27	23.20	0.83
Mother's Mental Health			
Depression score (Hamilton)	14.77	14.37	0.19
Disability score (BDQ)	8.08	8.27	0.34
Perceived Social Support score (MSPSS)	46.38	44.39	0.10
Family characteristics			
Joint/extended family structure	0.61	0.56	0.12
Grandmother lives with	0.55	0.44	0.00***
No. member per room	3.60	3.73	0.25
Father's characteristics			
Father's education	7.08	7.20	0.67
Father employed	0.89	0.91	0.50
Father's occupation non-manual worker	0.29	0.30	0.86
Household income and SES			
log(Income)	4.19	4.04	0.50
SES (1=Rich, 5=Poor)	3.57	3.65	0.33
Has debt	0.59	0.55	0.40
Household characteristics			
Electricity	0.95	0.93	0.22
Radio	0.49	0.46	0.49
TV	0.62	0.59	0.44
Refrigerator	0.38	0.31	0.05*
Bicycle	0.29	0.30	0.81
Air con	0.06	0.04	0.35
Washing machine	0.31	0.24	0.03**
Water pump	0.42	0.36	0.10
Car	0.07	0.06	0.84
Piped drinking water	0.08	0.06	0.34
Flush toilet	0.29	0.25	0.19
Brick/concrete walls	0.85	0.89	0.15
Sample size	357	347	704

* $p < .10$, ** $p < .05$, *** $p < .01$ Note: The table shows sample means by Treated and Control groups for characteristics measured at baseline for the full sample of THP women present at the 1-year follow-up. Column 3 shows the p-value of the difference in means between the treated and control groups.

Table 12 – Characteristics in 2013 by Baseline Depression Status

Sample Characteristics:	(1) Non-depressed	(2) Depressed	(3) P-value
Mother's characteristics			
Mother's age	34.06	34.73	0.10*
Mother's education	5.54	4.02	0.00***
Number of kids	4.00	4.31	0.00***
Number of kids born to mother in last 7 years	1.24	0.87	0.00***
Avg age if kids born to mother in last 7 yrs	3.68	3.71	0.81
Mother's general health (1=vgood 5=vbad)	2.87	3.14	0.00***
Mother's Mental Health			
Currently depressed (MDE)	0.11	0.27	0.00***
Perceived social support score (MSPSS)	41.69	37.94	0.00***
Recovered permanently	0.00	0.39	0.00***
Never recovered	0.00	0.13	0.00***
Depressed ever between 2008-2013	0.13	0.31	0.00***
Depressed between 2008-2013 (recall only)	0.03	0.14	0.00***
Number of recalled depressive episodes	0.03	0.15	0.00***
Number of depressive episodes since 2007	0.12	0.33	0.00***
Duration of recalled depressive episodes (yrs)	0.03	0.11	0.00***
Family characteristics			
Joint/extended family structure	0.60	0.60	0.93
Grandmother lives with	0.44	0.37	0.03**
Number of adults living with	4.14	3.72	0.01***
Father's characteristics			
Father's education	8.01	6.96	0.00***
Father employed	0.90	0.87	0.25
Father's occupation non-manual worker	0.09	0.05	0.01***
Household income and SES			
log(Income)	9.46	9.27	0.00***
SES (1=Rich, 5=Poor)	3.34	3.48	0.01***
Has debt	0.56	0.63	0.05**
Piped drinking water	0.06	0.08	0.28
Flush toilet	0.65	0.57	0.03**
Sample size	300	585	885

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

Note: The table shows sample means for characteristics for perinatally depressed and perinatally non-depressed mother measure at the time of the 2013 follow-up. Column 3 shows the p-value of the difference in means between the depressed and non-depressed groups.

Table 13 – 2013 Characteristics for Baseline Non-depressed Mothers by Treatment Assignment

Sample Characteristics:	(1) Treated UC	(2) Control UC	(3) P-value
Mother's characteristics			
Mother's age	34.27	33.84	0.48
Mother's education	6.23	4.85	0.01**
Number of kids	3.96	4.04	0.63
Number of kids born to mother in last 7 years	1.19	1.29	0.41
Avg age if kids born to mother in last 7 yrs	3.79	3.58	0.27
Mother's general health (1=vgood 5=vbad)	2.82	2.91	0.37
Mother's Mental Health			
Currently depressed (MDE)	0.09	0.13	0.20
Perceived social support score (MSPSS)	42.26	41.13	0.36
Depressed ever between 2008-2013	0.12	0.14	0.61
Depressed between 2008-2013 (recall only)	0.04	0.01	0.15
Number of recalled depressive episodes	0.04	0.01	0.15
Number of depressive episodes since 2007	0.09	0.14	0.24
Duration of recalled depressive episodes (yrs)	0.04	0.01	0.24
Family characteristics			
Joint/extended family structure	0.63	0.56	0.20
Grandmother lives with	0.49	0.40	0.13
Number of adults living with	4.28	4.01	0.38
Father's characteristics			
Father's education	8.13	7.89	0.56
Father employed	0.89	0.90	0.75
Father's occupation non-manual worker	0.13	0.05	0.01***
Household income and SES			
log(Income)	9.55	9.38	0.05**
SES (1=Rich, 5=Poor)	3.28	3.41	0.15
Has debt	0.57	0.55	0.75
Piped drinking water	0.08	0.05	0.24
Flush toilet	0.69	0.61	0.12
Sample size	150	150	300

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

Note: The table shows sample means by treatment Union Council for characteristics measure at the time of the 2013 follow-up. Column 3 shows the p-value of the difference in means between the treatment UC and control UC groups.

Table 14 – Effect of Treatment on Maternal Mental Health Outcomes: Heterogeneous Effects by Gender at baseline

Dependent variable:	Currently dep. (MDE) (1)	Dep. ever btw 2008-13 (2)	Dep 2008-13 (recall only) (3)	# of MDEs recall & curr (4)	Duration of MDEs (yrs) (5)	Recovered permanently (6)	Never recovered (7)	MSPSS score (8)
<i>Panel A: Boys</i>								
Treated	0.029 (0.05)	-0.015 (0.04)	-0.071** (0.03)	-0.067* (0.03)	-0.029 (0.03)	0.19*** (0.05)	-0.053 (0.05)	2.79* (1.4)
Mean of dep. var	0.26	0.29	0.14	0.17	0.15	0.45	0.16	37.7
Observations	289	289	289	289	289	289	289	289
<i>Panel B: Girls</i>								
Treated	-0.097** (0.04)	-0.080* (0.04)	-0.0051 (0.04)	-0.049 (0.06)	0.012 (0.05)	0.25*** (0.05)	-0.18*** (0.03)	2.10* (1.0)
Mean of dep. var	0.28	0.33	0.14	0.19	0.13	0.48	0.16	38.1
Observations	296	296	296	296	296	296	296	296

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

Note: Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All models are OLS and include interviewer fixed effects. 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, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared (including baseline SES doesn't alter the results).

Table 15 – Maternal Mental Health Outcomes: Heterogeneous Effects by Grandmother present at baseline and gender

Dependent variable:	Currently dep. (MDE) (1)	Dep. ever btw 2008-13 (2)	Dep 2008-13 (recall only) (3)	# of MDEs recall & curr (4)	Duration of MDEs (yrs) (5)	Recovered permanently (6)	Never recovered (7)	MSPSS score (8)
Panel A: Boys – Grandmother not present at baseline								
Treated	-0.11* (0.06)	-0.19*** (0.06)	-0.22*** (0.05)	-0.25*** (0.06)	-0.19*** (0.06)	0.40*** (0.08)	-0.14* (0.07)	4.66** (2.0)
ymean	0.28	0.33	0.16	0.20	0.18	0.35	0.20	36.3
N	141	141	141	141	141	141	141	141
r2	0.25	0.26	0.32	0.31	0.15	0.28	0.21	0.26
Panel B: Boys – Grandmother present at baseline								
Treated	0.17*** (0.06)	0.16** (0.06)	0.059* (0.03)	0.100* (0.05)	0.094** (0.04)	-0.0077 (0.07)	0.032 (0.06)	1.26 (1.9)
ymean	0.24	0.26	0.12	0.15	0.12	0.55	0.11	39.1
N	148	148	148	148	148	148	148	148
r2	0.35	0.35	0.34	0.31	0.31	0.25	0.16	0.34
Panel C: Girls – Grandmother not present at baseline								
Treated	-0.081 (0.07)	-0.11* (0.06)	-0.032 (0.06)	-0.095 (0.1)	-0.027 (0.06)	0.20*** (0.06)	-0.26*** (0.05)	2.56 (1.7)
ymean	0.34	0.40	0.14	0.19	0.10	0.41	0.19	36.9
N	153	153	153	153	153	153	153	153
r2	0.18	0.24	0.31	0.33	0.25	0.27	0.32	0.32
Panel D: Girls – Grandmother present at baseline								
Treated	-0.13** (0.06)	-0.029 (0.07)	0.071 (0.06)	0.068 (0.09)	0.11 (0.09)	0.33*** (0.09)	-0.14** (0.06)	0.55 (1.7)
ymean	0.22	0.27	0.14	0.18	0.15	0.56	0.13	39.4
N	143	143	143	143	143	143	143	143
r2	0.20	0.20	0.26	0.24	0.21	0.26	0.21	0.36

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

Note: Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All models are OLS and include interviewer fixed effects. 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, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared (including baseline SES doesn't alter the results).

Table 16 – Maternal Mental Health Outcomes: Heterogeneous Effects by Grandmother present at baseline and gender

Dependent variable:	Mother's depression status at followups after		
	6 months (1)	1 year (2)	7 years (3)
Panel A: Boys – Grandmother not present at baseline			
Treated	-0.40*** (0.09)	-0.43*** (0.09)	-0.11* (0.06)
ymean	0.52	0.57	0.28
N	141	141	141
r2	0.33	0.24	0.25
Panel B: Boys – Grandmother present at baseline			
Treated	-0.24*** (0.08)	-0.12 (0.09)	0.17*** (0.06)
ymean	0.27	0.31	0.24
N	147	147	148
r2	0.22	0.18	0.35
Panel C: Girls – Grandmother not present at baseline			
Treated	-0.31*** (0.07)	-0.37*** (0.06)	-0.081 (0.07)
ymean	0.37	0.44	0.34
N	153	153	153
r2	0.34	0.37	0.18
Panel D: Girls – Grandmother present at baseline			
Treated	-0.26*** (0.09)	-0.33*** (0.1)	-0.13** (0.06)
ymean	0.29	0.36	0.22
N	143	143	143
r2	0.21	0.22	0.20

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

Note: Heterogeneity robust standard errors, clustered by Union Council, in parentheses. All models are OLS and include interviewer fixed effects. 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, Hamilton score, Hamilton-squared, BDQ score, BDQ-squared, MSPSS score, and MSPSS-squared (including baseline SES doesn't alter the results).