Graduate School of Development Studies

Effect of Maternal Mental Health on Cognitive Achievement of Children: Evidence from Ethiopia

A Research Paper presented by:

Samuel Gidey Weldeegzie
Ethiopia

In partial fulfilment of the requirements for obtaining the degree of
MASTERS OF ARTS IN DEVELOPMENT STUDIES

Specialization:
Economics of Development
ECD

Members of the examining committee:

Dr. Robert Sparrow
Prof. Dr. Arjun Bedi

The Hague, The Netherlands
November, 2011

Disclaimer:

This document represents part of the author's study programme while at the Institute of Social Studies. The views stated therein are those of the author and not necessarily those of the Institute.

Inquiries:

Postal address:	Institute of Social Studies P.O. Box 29776 2502 LT The Hague The Netherlands
Location:	Kortenaerkade 12 2518 AX The Hague The Netherlands
Telephone:	+31 70 426 0460
Fax:	+31 70 426 0799

Contents Pages

List of Tables

List of Figures

List of Acronyms

ANOVA=Analysis of Variance
BLS=Bavarian Longitudinal Survey
CDA=Cognitive Development Assessment
CLAD=Censored Least Absolute Deviation
CMD=Common Maternal Depression
CMM=Colombian Mental Maturity Scale
EPDS=Edinburgh Postnatal Depression Scale
HOME=Home Observation for Measurement of the Environment Scale
IQ=Intelligence Quotient
K-ABC=Kaufman Assessment Battery for Children
MLH=Maximum Likelihood
OLS=Ordinary Least Squares
PPVT=Peabody Picture Vocabulary Test
SES=Socio-economic Status
SNNP=Southern Nations, Nationalities and Peoples
SRQ20=Self –reporting Questionnaire 20 Items
TVIP=Spanish version of the PPVT
WHO=World Health Organization

[1]Acknowledgment

My first gratitude goes to God-The Almighty. Next, I would like to thank my advisor, Dr. Robert Sparrow, for his invaluable help throughout the research process till the end. All his comments were extremely constructive. I would also like to thank my second reader, Prof. Arjun Bedi, for his invaluable advice since the inception of the paper.

I shall give credit to all my awesome friends, for being true friends and sharing my happiness and problems I have had to date. I owe credit to Sangya Kaphle for help in editing the paper. Many thanks to the Dutch government for awarding the very generous scholarship that enabled me to follow my education without any financial difficulty.

Finally, I owe much credit to my family, especially my mother. "Adeye" you are a lot to me and I love you much. Ohh…Desta, my missed brother…I owe you ALL the good credit that is in me. I can't forget that you were an exceptional brother who played the most significant role in my life.

[1] *'The data used in this publication comes from Young Lives, a 15-year survey investigating the changing nature of childhood poverty in Ethiopia, India (Andhra Pradesh), Peru and Vietnam (www.younglives.org.uk). Young Lives is core-funded by UK aid from the Department for International Development (DFID) and co-funded from 2010 to 2014 by the Netherlands Ministry of Foreign Affairs. The views expressed here are those of the author(s). They are not necessarily those of Young Lives, the University of Oxford, DFID or other funders.'*

Abstract

This study examines the association between maternal mental health and cognitive achievement of Ethiopian children. It matches more than 1300 children and their mothers using two rounds of the Young Lives data set, which contains a relatively large sample size, unique outcome variables (test of cognitive achievement-PPVT and CDA), that allow less scope for bias of the test conductors, and rich set of control variables capturing child and household specific characteristics.

Many early childhood studies argue that maternal depression at an early age of the child can have a lasting impact on cognitive achievement at later ages. This claim has important policy implications, as there is well documented evidence that early childhood cognitive achievement significantly affects future life outcomes. If maternal mental health is significant in affecting the cognitive achievement of children, then it means that attention should be paid to maternal mental health not only for the sake of the mother but also for the child. That is, policy concern on maternal mental health should not be focused merely on maternal health but rather, should go beyond and become the issue of generational wellbeing since the effect trickles down to the child.

The results of this study, however, suggest that maternal (postnatal) depression when a child is about one year old does not have any association with the cognitive achievement of the child five years later. In addition, maternal depression is not associated with child nutritional status. However, higher self-esteem of the mother is found to have a positive and significant association with child cognitive achievement but not with child nutritional status. The possible implication is that maternal mental health per se is not a problem at least from the prospective of child cognitive achievement as the former was not (negatively) associated with the latter.

Keywords

Child development, cognitive achievement, PPVT, CDA, SRQ20, maternal depression, self-esteem

Section I: Introduction

Depression is one amongst the major worldwide public health issues. It has a negative impact on all aspects of an individual's life and can even lead to suicide. It could affect the ability to work, sleep, eat, enjoy, and parent, all of which affects all aspects of work and family life (Knitzer, Theberge and Johnson 2008). Statistically, women (particularly pregnant women and new mothers) are at increased risk for depression (Sohr-Preston and Scaramella 2006). Approximately, 12 percent of all women experience depression in a given year (Knitzer, Theberge and Johnson 2008). In Ethiopia, about 33% of nearly 2000 sampled caregivers are classified as "case" depressed with no difference between the rural from the urban sample. It is obvious that the country is one of the least developed countries in the world. The World Bank[2] estimate show that the percentage of population below the national poverty line was about 38.9% in 2005.

It is argued that many children in poor countries are exposed to multiple risks, including poverty, malnutrition, poor health, and unstimulating home environments, which negatively affect their cognitive, motor, and socio-emotional development (Grantham-McGregor et al. 2007). Moreover, Poverty is associated with increased maternal stress, depression and inadequate stimulation in home environment. These could affect early childhood cognitive development (Aber et al. 1997, Bradley and Corwyn 2002, Grantham-McGregor et al. 2007).

This study is aimed at examining the effect of maternal mental health on cognitive achievement of Ethiopian children. Specifically, it has two objectives: the first is to examine whether maternal depression during early life of the child (when the child is about one year old) is associated with cognitive achievement of the child at five years old. The second is to investigate whether self esteem of the mother is associated with the child cognitive achievement. The study matches more than 1300 children and their mothers using two rounds of Young Lives data set which tracks the development of nearly 2000 children from five regions of Ethiopia. It focuses on the aforementioned area because of reasons elaborated subsequently.

Many early childhood studies argue that maternal depression at early age of the child can have lasting impact on cognitive achievement of children at later ages (Caplan et al. 1989, Cogill et al. 1986, Hay et al. 2001, Menash and Kierman 2010). This has an important policy implication because if maternal mental health is significant in affecting the cognitive achievement of children, then it would mean that attention should be paid to maternal mental health not only for the sake of the mother but also for the child. If the later is the case, policy concern on maternal mental health should not be focused merely on maternal health. Rather, it may go beyond and become the issue of generational wellbeing. Cognitive achievement at early childhood could affect school

[2] http://data.worldbank.org/country/ethiopia

achievement later which may further affect adult wellbeing. "Disadvantaged children in developing countries who do not reach their developmental potential are less likely to be productive adults" (Grantham-McGregor et al. 2007). Cognitive competence is also crucial to the development of emotional, social and physical competence (Minor, 1973). Furthermore, there is increasing amount of literature suggesting that low level of cognitive development in early childhood can have adverse long-term consequences for adult wellbeing (Grantham-McGregor et al, 2007, Paxson and Schady 2005, Todd and Wolpin 2003). Therefore, knowing whether maternal mental health has lasting association with the child cognitive achievement is relevant from policy perspective as the evidence that early childhood cognitive achievement significantly affects future life outcomes is already well documented (Grantham-McGregor et al. 2007, Todd and Wolpin 2003).

According to WHO (2009)[3], every year more than 200 million children who are under five years old fail to reach their full cognitive and social potential. There could be several reasons for this. Both nature (genetics) and nurture (environment) play significant roles in affecting child cognitive outcome (Grantham-McGregor et al. 2007, Kliegman 2007). Of the environmental factors, maternal characteristics play an important role due to several reasons. First, brain growth is more prominent during late gestation and in the early years of life during which the child is highly attached to the mother physically (Abbott et al. 1998, WHO 2008). "*The most dramatic events in growth and development occur before birth and involve the transformation of a fertilized egg into an embryo and a fetus, the elaboration of the nervous system, and the emergence of behaviour in utero*" (Kliegman 2007).

Second, child care plays a key role in day-to-day safety, health and well being of the child, which depends crucially on mother child-interaction (Aboud and Alemu 1995). Mothers largely constitute infants' social environment and mediate their experience of the external world (Stewart et al. 2003). That is, a child who gets high-quality child care characterized by warm, responsive, and stimulating interactions between his/her caregiver tends to become more likely healthier and mentally active than a child who experiences poor parenting quality-negative mother-infant interaction such as insecure attachment, neglect and family conflict (Kliegman 2007, Meadows et al. 2007, Stewart et al. 2007).

Third, child-mother interaction also affects the way mothers feed their children thus determining their growth (Medhin et al, 2010). Child malnutrition is associated with child health, and good health has been linked to improvements in cognitive ability and faster mental development (Rubalcava and Teruel 2004). The prevalence of nutritional deficiency in early childhood is closely associated with both poor physical health and cognitive and educational achievement of children (Dercon and Hoddinott 2005, Grantham-McGregor et al. 2007, Hoddinott and Kinsey, 2001).

[3] http://www.who.int/mediacentre/factsheets/fs332/en/index.html

There exists some empirical literature investigating the effect of maternal mental health on health and nutrition of children. Medhin et al. (2010) and Ross et al. (2011) investigated the effect of maternal common mental disorders (CMD) on infant under nutrition and the risk of key illnesses of early infancy, namely: diarrhoea, fever and acute respiratory illnesses (ARI) in Butajira, Ethiopia. The former found no significant association between CMD and nutritional status of infants. The later found that persistent perinatal CMD symptoms were associated with increased risk of infant diarrhoea but not with infant fever or ARI when confounding factors are controlled. Harpham et al. (2005) also investigated the association between CMD and nutritional status and found no clear association between the two when using the Ethiopian sample[4]. This study is different from these previous ones in that it examines the effect of maternal (postnatal) depression and self esteem on cognitive achievement of children. It goes beyond examining nutritional effects.

Empirical studies carried out in developed countries show mixed result. For instance, studies conducted by Kurstjens and Wolke (2001) and Murray et al. (1996), from Germany and UK respectively, found no link between maternal depression and cognitive outcome of children. Authors like Menash and Kierman (2010), Hay et al. (2001), Caplan et al. (1989), and Cogill et al. (1986) found significant association between maternal depression and child's intellectual achievement in the UK. However, most of these studies, if not all, suffer from subjectivity bias of the teachers and mothers in rating behavioural and cognitive outcome of the index child. In addition, they use small sample size and fail to control for various child and household characteristics. The details of what these authors carried out are left for discussions under the literature review section.

So far, there is no single empirical study conducted in Ethiopia that investigates the link between maternal mental health and cognitive achievement of children. And it may be misleading to conclude based on what other authors found out in other countries because (1) the literature to date show mixed result, (2) whatever evidence obtained from other countries may not necessarily suggest the same thing for Ethiopia, and (3) obviously each study suffers from its own limitations. This study makes use of relatively large sample size, unique outcome variable (test of cognitive achievement-PPVT and CDA), which has less room for bias of the test conductors, and controls for more child and household specific covariates, to addresses the concern. The results suggest that maternal (postnatal) depression when the child is about one year old has no any association with the cognitive achievement of the child later at five years. In addition, maternal depression was also not associated with child nutritional status. Specifically, we do not find evidence that maternal depression is linked to child weight at early age (age one) or height of the child four years

[4] The authors used all the four countries included in the Young Lives Longitudinal Survey, and found no clear relationship between high maternal CMD and poor child nutritional status in Ethiopia and Peru, while they found significant association in India and Vietnam.

later. However, higher self-esteem of the mother was found to have a positive and significant (at least at 10% level of significance) association with child cognitive achievement but not with child nutritional status. The possible implication is that maternal mental health per se is not a problem at least from the prospective of child cognitive achievement as the former was not (negatively) associated with the latter.

The rest of the paper is organized as follows. Section two presents reviews of theoretical and empirical literature. Section three focuses on data and methodological issues. The fourth section puts forward the results and the last section presents concluding remarks.

Section II: Review of Literature

2.1 Theoretical frame work: transmission mechanisms

The theoretical framework emanates from the argument that says cognitive development is a cumulative process in which past inputs contribute to the present cognitive achievement of the child (Todd and Wolpin 2003). As cited in most Early Childhood Development (ECD) literatures, children's cognitive achievement could be determined by several child, parent, household and environmental specific factors. This study focuses on the association that maternal depression and self-esteem could have with the child cognitive achievement. These two variables of interest could affect child cognitive achievement directly or indirectly through various ways. Their indirect effect is mainly moderated by child-mother interaction. That is, these variables could initially affect child-mother interaction and this interaction could mediate the way these variables affect the child cognitive achievement. In addition, maternal depression and self-esteem could also have direct effect via physiological and biological pathways. The mechanisms by which these key variables affect the child cognitive achievement are illustrated in figure 1.

Maternal depression could affect the child cognitive development through two mechanisms. First, it could have physiological impact. Field (1995) argued that newborn infants of depressed mothers have been observed to exhibit lower cardiac vagal tone[5]. Vagal regulation supports the infant information processing which is important for language and cognitive development (Bornstein and Suess 2000 cited in Sohr-Preston and Scaramella 2006).

[5] "Vagal tone is proposed as a novel index of stress vulnerability and reactivity with applications in all branches of medicine, and with particular value in pediatrics. Measurement of cardiac vagal tone is proposed as a method to assess on an individual basis both the stress response and the vulnerability to stress"
http://pediatrics.aappublications.org/content/90/3/498
Vagal tone is to mean resting heart beat. The degree of variability of the heart rate for each respiratory cycle is determined by Vagus nerve. When the heart rate varies considerably for each respiratory cycle, then we say there is good or high vagal tone
http://www.iworx.com/support/manuals/pieces/214_bp1L.pdf

Maternal depression could also affect the infant's electrical brain activity measured by electroencephalogram (EEG). And

> "…*EEG research has linked electrical frontal brain activity in the right and left hemispheres to meaningful behavioural and emotional patterns. Left frontal electrical activity is generally associated with approach and positive emotionality, whereas activity in the right frontal hemisphere appears related to withdrawal and negative emotionality. Infants and toddlers of depressed mothers have been found to exhibit less left frontal electrical brain activation and more right frontal activation than children of non-depressed mothers. Tendencies towards withdrawal and negative affect are significant for cognitive and language development because negative emotional states likely disrupt infants' readiness to process and respond to external stimuli. In other words, infants of depressed mothers may be less likely to approach and process novel objects and situations and, thus, benefit less from early learning opportunities*"- (Sohr-Preston and Scaramella 2006).

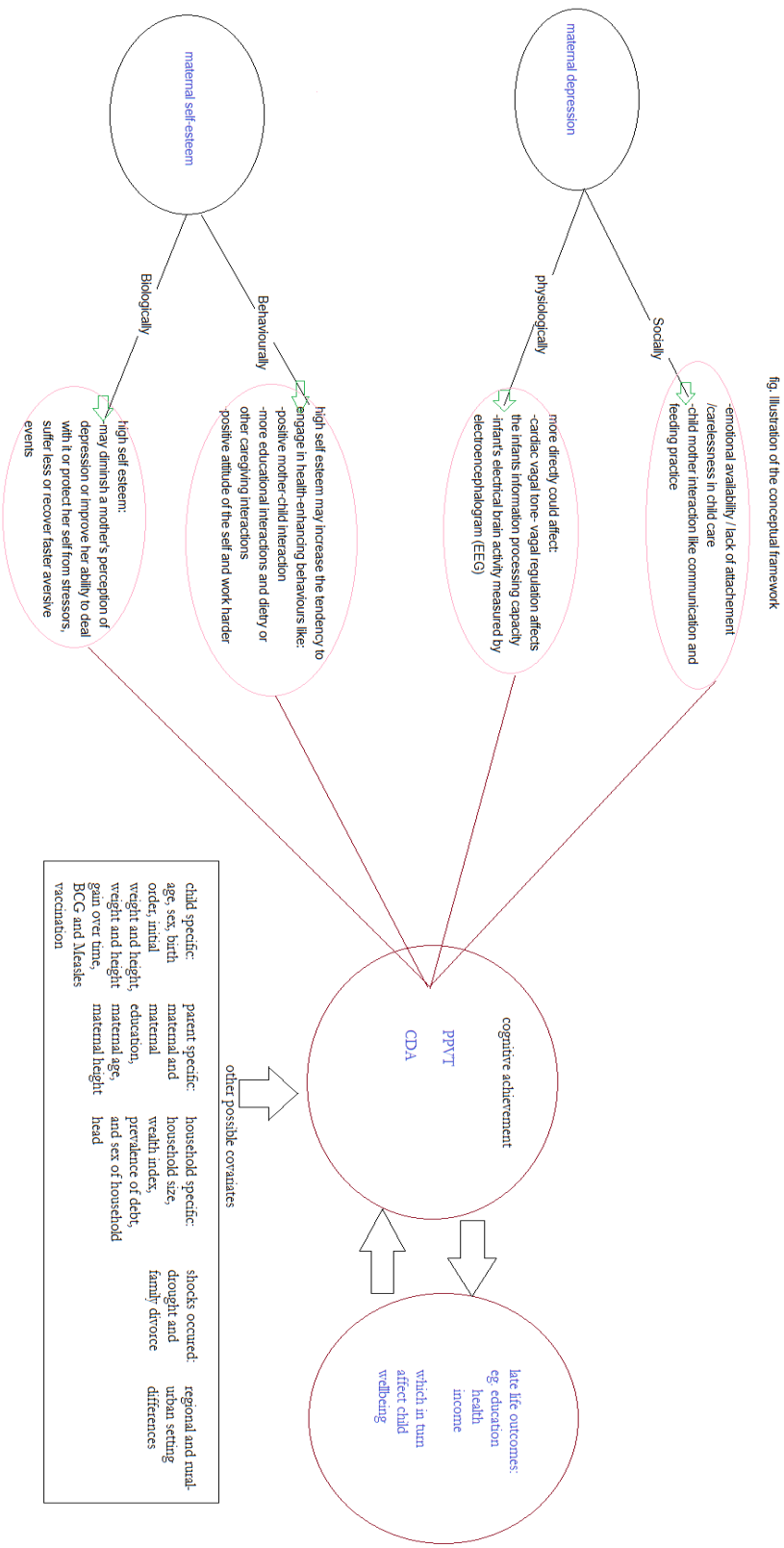
Second, maternal depression may affect the child's cognitive development socially. Knitzer, Theberge and Johnson (2008) argue that maternal depression is a significant risk factor in affecting the well-being and school readiness of young children. It's stated that depressed mothers are mentally and physically less available to the child and hence compromise parenting quality (Bettes 1988, Field, Healy and LeBlanc 1990, Livingood, Daen and Smith 1983). They might also be reluctant to breastfeeding, cease breastfeeding early or compromise hygienic feeding practices, putting the infant at risk of infectious diseases (Medhin et al. 2010, Stewart et al. 2003, WHO 2008). Depressed mothers are also more likely to have a negative image of themselves as parents and hence may consider themselves as less powerful agents to control their children's development, and less able to positively influence their children (Goodman et al. 1993, WHO 2008). These variables could also affect directly through thinking process of depression (Cummings and Davies 1994).

Another closely related variable to maternal mental health and child-mother interaction is self esteem of the mother. It could also have a significant association with the cognitive development of children. Surkan et al (2008) argued that increased levels of maternal self-esteem are associated with better neurodevelopmental tests scores. According to these authors, there are several potential mechanisms through which self-esteem could affect cognitive development of children. These could be behavioural pathways, biological pathways or both. With regard to behavioural pathways, high self-esteem might increase the general tendency for a person to engage in a wide variety of health-enhancing behaviours (Abood and Conway 1992, Surkan et al. 2008). Surkan and his co-authors argued that higher self-esteem may be associated with positive mother-child interactions, such as more educational interactions, improved dietary practices, or other care giving practices that may lead to children's improved cognitive abilities. In addition, positive attitude of the self could also be associated with working harder and longer on tasks (Felson 1984). Furthermore, self-esteem may be a sign of parenting qualities not captured by other covariates (Surkan et al. 2008).

> The ability to care for others appears to be associated with positive illusions in that illusions are associated with certain aspects of social bonding. The capacity for creative, productive work is fostered both by enhanced intellectual functioning, which may be an outgrowth of positive illusions and by the increased motivation, activity level, and persistence that are clearly fostered by a positive sense of self, a sense of control, and optimism. (Taylor and Brown 1988)

Through biological pathways, mother's higher self-esteem may help to diminish a mother's perception of stress or improve her ability to deal with it. If the mother has high self-esteem, it may help her to protect herself from stressors, suffer less or recover faster from aversive events (Baumeister et al. 2003, Creswell et al. 2005, and Surkan et al. 2008).

Figure 1: Pathways through which maternal depression and self esteem affect child's cognitive development.



2.2 What is cognitive development and why to worry about it?

Some authors suggest that the term cognition encompasses a range of mental processes, including perception, attention, language, reasoning and memory (Ford 2004 p.7). However, cognitive development is too wide an area to be defined or explained concisely in one theory.

According to WHO (2009)[6], every year more than 200 million children who are under five years old fail to reach their full cognitive and social potential. It also mentioned that early childhood is the most intensive period of brain development during one's life span and rapid brain development affects cognitive, social and emotional growth of children.

The primary issue in cognitive development, among others, is the question of nature versus nurture. That is, whether a child's cognitive development depends on innate (genetically determined) ability or environmental factors such as family background and schooling (Ford 2004, Plug and Vijverberg 2003, Sternberg 2002). This could also be related to an issue of modifiability. Sternberg (2002) argued that "*at one time, it was believed that cognitive abilities are fixed, and that we are stuck for ever with whatever level of cognitive abilities we have at birth. Today, many researchers believe that cognitive abilities are malleable-that the skills derived from these abilities can be shaped and even increased through various kinds of interventions.*" It is now clear that both factors (nature and nurture) play significant roles in determining children's cognitive achievement. Grantham-McGregor et al (2007) also argued that brain development is modified by the quality of the environment. According to these authors, "*animal research shows that early under nutrition, iron-deficiency, environmental toxins, stress, and poor stimulation and social interaction can affect brain structure and function, and have lasting cognitive and emotional effects.*"

Greenough et al. (1987) put forward that experience of the organism, both in times of early postnatal period and at later ages of maturity of the nervous system, plays a vital role in normal brain development. This is because cortical patterning remains malleable for an extended period of time although it begins in the embryonic period. In the words of Stiles and Jernigan (2010), "*typical, expected, postnatal experience is necessary for the emergence of normal patterns of neocortical organization. When that input is lacking brain areas develop differently and the specific pattern of development reflects the kinds of input that the organism actually received.*" According to Greenough and his co-authors, during earlier periods, brain becomes "experience expectant" while at later ages, it becomes "experience dependent" emphasising the importance of experience in brain development. Accordingly, Stewart et al. (2003) explain how mothers largely constitute infants' social environment and mediate their experience with external world.

[6] http://www.who.int/mediacentre/factsheets/fs332/en/index.html

Research demonstrating the profound impact of early experience on the development of the brain (neural plasticity) has illuminated the interaction of nature and nurture. The brain comprises 100 billion neurons at birth, with each neuron developing on average 15,000 synapses by 3 yr of age. The number of synapses stays roughly constant through the first decade of life as the number of neurons declines. Synapses in frequently used pathways are preserved, whereas less-used ones atrophy. Thus, experience (nurture) has a direct effect on the physical properties of the brain (nature). Children with different talents and temperaments (nature) also elicit different stimuli from their environment (nurture)" (Kliegman et al 2007).

Thus, parental characteristics are among the factors that provide significant input and shape the experience of child development, more specifically mental development of the child. Besides, early cognitive and social-emotional developments are strong determinants of school progress and even future wellbeing of the generation (Grantham-McGregor et al 2007). Hence studying this has something to do with intergenerational wellbeing.

2.3 Maternal depression, self-esteem and child development

Worldwide, mental illness is amongst the most widespread and disabling illnesses. As cited in the works of Frank and McGuire (2000), in the US, approximately 30% of the population is estimated to experience some diagnosable mental or addictive disorder in a one year period. "*The most severe mental disorders, schizophrenia, manic depression, and some form of manic depression affect about 4% of the population each year and are very disabling"* (Frank and McGuire 2000).

Depression is one of the major worldwide public health issues. It has a negative impact on all aspects of an individual's life including work and family and can even lead to suicide (Knitzer, Theberge and Johnson 2008). And as cited in these authors, approximately 12 percent of all women experience depression in a given year. "*Considering the situation of parenting, depression could indicate a combination of symptoms that interfere with the ability to work, sleep, eat, enjoy, and parent, all of which affects all aspects of work and family life7. Maternal depression by itself or added to other risks can pose serious, but typically unrecognized barriers to healthy early development and school readiness, particularly for low-income young children"* (Knitzer, Theberge and Johnson 2008). These authors also argued that the impact of depression varies by its timing (maternal depression during infancy has a bigger impact on a child's development than later exposure), its severity, and the length of time it persists.

[7] http://www.nimh.nih.gov/health/publications/depression/complete-index.shtml

Parents with depression often have problems effectively relating to their children. For example, they tend to be less responsive to their children while interacting with them, exhibit fewer positive social behaviours, and complain to their children about their own problems as well as their child's behaviour more than non-depressed parents do. These disrupted parenting behaviours appear to have negative consequences for children. The children of depressed parents show signs of rejection and agitation, even during infancy. They make less eye contact with their parent, express more negative emotion, and are less content than children who are with non-depressed parents. Parents afflicted with depression are 4 times more likely to have children who are depressed than are parents who are not depressed. This increased risk for depression among the offspring of depressed parents is the result of both genetic and environmental factors. The environmental factors include those disrupted parenting and social behaviours mentioned previously that apparently have depressogenic (i.e., depression inducing) effects on children. (Encyclopaedia of Human relationships V-I, March 2009 p.399)

As presented by Nancy and Stewart (2004)[8], Blascovich & Tomaka (1991) defined self-esteem as the evaluative component of the self-concept, a broader representation of the self that includes cognitive and behavioural aspects as well as evaluative or affective ones. Maternal personality traits, such as self esteem, may buffer maternal stressors or lead to improved maternal–child interactions that directly impact neurodevelopment and hence cognitive development of the child (Surkan et al 2008). "*Despondency in parenting, and the resulting psychological unavailability of primary caregivers, can operate as a precursor to child maltreatment with potentially severe detrimental effects on the physical, socioemotional, and cognitive development of children in the most extreme cases*" (Coleman and Karraker 1997).

Maternal self-esteem could affect child cognitive achievement through a number of mechanisms. According to Coleman and Karraker (1997), parenting self-efficacy can directly impact the quality of care provided as well as the degree of enjoyment derived from the parenting experience. High self-esteem could positively influence the behaviour and development of their children (Coleman 1998). Surkan et al, 2008 spelled out the mechanisms via which maternal self esteem could affect children's cognitive development. Similar to the mental health pathways, they show that there are various behavioural or biological mechanisms, such as more educational interactions, improved dietary practices, or other care giving practices that may lead to children's improved cognitive abilities, arising through positive mother child interactions for mothers with higher self esteem. High self-esteem might increase the general tendency for a person to engage in a wide variety of health-enhancing behaviours (Abood and Conway 1992). Positive attitude of the self could also be associated with working harder and longer on tasks and ultimately may benefit from a given opportunity (Felson 1984).

[8] http://www.macses.ucsf.edu/research/psychosocial/selfesteem.php

Self-esteem of the mother may also diminish a mother's perception of stress or improve her ability to deal with it. If the mother has high self-esteem, it may help her to protect herself from stressors, suffer less or recover faster from aversive events (Baumeister et al. 2003, Creswell et al. 2005, and Surkan et al. 2008). Furthermore, self-esteem may be an indicator of parenting qualities not captured by other covariates (Surkan et al 2008).

2.4 Review of empirical literature

Widespread empirical evidence leaves little doubt of the importance of parenting in children's social, emotional, and behavioural development (Kiff et al. 2011). However, empirical evidences showing that maternal depression significantly affects the quality of parenting, or child mother interaction and subsequent child outcomes such as nutritional status and cognitive achievement are quite mixed. Some of these empirical literatures are discussed in this section.

As to our knowledge, there is no empirical literature directly addressing the relationship between maternal depression and cognitive outcome of Ethiopian children. However, some studies in relatively similar areas are available. For instance, Aboud and Alemu (1995) analysed mental development of just 40 children (in a small village of Ethiopia called Woyo Gebriel) and its relation to the children's nutritional status and mother-child interaction. They found that the child's weight for age was significantly related to the child's score of Bayley Scale of Mental Development. They also found that poorer verbal scores were related to a lower rate of mother's verbal responses, but the mother's responsiveness was unrelated to the child's nutritional status. However, they did not control for various child and household factors.

Another study by Mulatu (1995) looked into the prevalence and risk factors of psychopathology in Ethiopian children aged 6-11 years living in Jimma town. 611 randomly selected mothers were interviewed about the presence of child behaviour problems. The study found high prevalence rates of common syndromes such as aggressiveness, anxiety, depression etc among these children (21.45% for boys and 25.17% for girls), and that children whose mothers reported more psychiatric symptoms for themselves tended to score higher on at least one of the pathology subscales. That is, the stronger predictor of child psychopathology was the maternal mental symptoms. In order to reduce any bias that could result from having the mother to rate both the child and herself, the author observed ratings from second informant close to the child and hence concluded that the correlation is relatively accurate.

With a direct focus on maternal depression, a study by Medhin et al (2010) investigated the effect of maternal common mental disorders (CMD) on infant under nutrition in Butajira, Ethiopia. It selected 1065 women, to be followed up with their new born up to one year postnatal, based on pregnancy within their third trimester, ability to communicate in Amharic, being a resident of the DSS site, and consenting to participate in the study. It found that a prevalence of CMD was 12% during pregnancy and 5% at the two month postnatal time-point. It also found that antenatal CMD predicted underweight at twelve months. However, the associations between CMD and infant nutritional status were not significant after adjusting for pre-specified potential con-

founders. A similar study by Ross et al. (2011), using the same data as Medhin et al (2010), investigated the impact of perinatal CMD on the risk of key illnesses of early infancy: diarrhoea, fever and acute respiratory illnesses (ARI) and explored the potential mediating role of maternal health behaviours. The authors found that persistent perinatal CMD symptoms were associated with 2.15 times increased risk of infant diarrhoea but was not associated with infant ARI or fever in a fully adjusted model. The strength of association was not affected by including potential mediators like breast feeding practices, hygiene, the infant's vaccination status or impaired maternal functioning.

Studies conducted by Harpham et al. (2005) and Hazarika (2010) used the same rounds of data set from Young Lives, to examine the effect of maternal mental health on nutritional status of children. The former used all the four countries included in the Young Lives Longitudinal Survey, and found no clear relationship between high maternal CMD and poor child nutritional status in Ethiopia and Peru, while it found significant association in India and Vietnam. The latter also did not find significant association between maternal mental health and child growth in India. These four aforementioned studies did not go beyond nutritional status, to see the effect of maternal depression on cognitive achievement of children, which is the primary objective of this study.

When looking into the studies focused on developed countries, studies conducted by Kurstjens and Wolke (2001) and Murray et al. (1996) from Germany and UK respectively found no link between maternal depression and cognitive outcome of children. The former used a comparison of 92 depressed and 721 non depressed mothers to compare differences in their respective children's cognitive achievement. The latter used about 100 mother-infant pairs from a specific hospital. Authors of both studies tried to take randomly selected sub-sample of mothers from given sample and classify into depressed and non-depressed (control) groups. However, the fact that the sub-sample is selected randomly from a given subjects may not ensure that depression is randomized. The preferred approach would then be to control for as much as possible all covariates that could potentially affect child cognitive outcome. This study tried to control for most of these covariates.

Another group of authors like Menash and Kierman (2010), Hay et al. (2001), Caplan et al. (1989) and Cogill et al. (1986), all from UK, found significant association between maternal depression and child's intellectual achievement. The first study dealt with sufficiently large sample (4,781 children) using Tobit regression. However, assessment of the child's cognitive achievement was made by the teacher that may lead for subjectivity bias. In addition, significance of the variable decreases as the model adjusts for some covariates. Furthermore, the model did not control for other various covariates like nutrition of the child. The rest of the aforementioned studies could also suffer from subjectivity bias of the teachers and mothers in rating behavioural and cognitive outcome of the child. In addition, they used small sample size and failed to control for various child and household characteristics. This study makes use of the benefit arising from relatively large sample size, unique outcome variable (test of cognitive achievement), less bias of the test conductors, and is able to control for more child specific and household specific covariates.

Furthermore, Stewart et al. (2003) provide a detailed review of literatures done before/on 2000 under the headings "postpartum depression: literature review of risk factors and interventions". Especially on third chapter of this review, the authors reviewed 78 relevant articles on the effect of postpartum depression on the mother-infant relationship and child growth and development. And the summary of key findings in the words of these authors is:

> *"Current research suggests that postpartum depression has salient but selective effects on the mother-infant relationship, and child growth and development. The strongest effects of postpartum depression are on cognitive development such as language, and IQ. Meta-analyses support medium to large effect sizes of postpartum depression on mother-infant relations in the first year postpartum. The odds are 5.4 times higher for 18-month old infants of postpartum depression mothers to display insecure attachment compared to infants of non-postpartum depression mothers. Postpartum depression may also lead to the early cessation of breastfeeding. With regard to emotional growth and development, studies support an early effect of PPD on infant affect, but do not support more longitudinal effects. Behavioural effects are variably supported, but may persist up to 5 years postpartum and beyond."* (Stewart et al. 2003 p.201)

Section III: Methodology

3.1 Data, Variables of interest and Descriptive Statistics

The data set comes from the Young Lives panel data of two rounds-2002 and 2006. It is officially accessible in the website of UK Data Archive Study Number 5307. "*Young Lives is a longitudinal research project investigating the changing nature of childhood poverty. The primary objectives of Young Lives are: (i) to improve the understanding of causes and consequences of childhood poverty, (ii) to inform the development and implementation of future policies and practices that will reduce childhood poverty. It is tracking the development of 12,000 children in Ethiopia, Peru, India and Vietnam through qualitative and quantitative research over a 15-year period."* (Outes-Leon and Sanchez 2008). As of 2002, the study has been following two cohorts in each study country. The younger cohort consists of 2,000 children per study country having an average age of 1 year in 2002. The older cohort consists of 1,000 children per country aged between 7.5 and 8.5 in 2002 (Alemu et al. 2003, Cueto et al. 2009, Outes-Leon and Sanchez 2008, Woldehanna, Mekonnen and Alemu 2008). The focus in this study is only on the younger cohorts mainly because of the data availability and the reason that young children are more vulnerable to early experience in the process of parenting.

The data were collected in collaboration with the Ethiopian Development Research Institute and researchers from Addis Ababa University and save the children UK in Ethiopia (Alemu et al, 2003). The data set contains a detailed data/information on household, child and care giver characteristics, and

certain household shocks. However, data for certain variables are not available or accessible for both rounds. The sampling methodology adopted is known as sentinel site surveillance system[9]. It is essentially the same as Primary Sampling Unit (PSU) that uses area sampling. That is, geographic areas are used as sampling units.

The sampling methods used in Ethiopia were a combination of multi-stage, purposive and simple random sampling. Initially, the first stage included selection of 5 regions (these are: Tigray, Amhara, SNNP, Addis Ababa, and Oromia) out of 9 regions based on national coverage. These five regions cover about 96 percent of the total population of the country. Of these regions, 20 sites (about 3-5 districts per region) were selected based on pro-poor bias, balancing Ethiopian regional and ethnic differences and also the cost of sampling (see the map in appendix). Areas of food deficiency were over-sampled and due to cost reasons the chance of excluding sites in remote areas was very high. In addition, at least one Peasant Association (PA) (in rural areas) or *kebele* (in urban areas) – the lowest level of administrative structure in the country – in each district was picked. The selected PA or *kebele* could either be considered as a sentinel site in its own right or as a centre for creating a sentinel site along with adjacent PAs or *kebele*s depending on the number of eligible households nearby. Eventually, 100 children who were born between April 2001 and June 2002 (for the younger cohorts group) and 50 children who were born between April 1994 and June 1995 (for the older cohorts group) were selected in each sentinel site using simple random sampling (Alemu et al. 2003, Outes-Leon and Sanchez 2008, Woldehanna, Mekonnen and Alemu 2008).

Despite the presence of skilled research team throughout data collection and cleaning, there could be certain limitations. For instance, Alemu et al. (2003) revealed that "*maternal health and mental health questions were difficult for respondents to understand. In some sentinel sites, even the enumerators were not comfortable asking the questions and supervisors had to intervene*." (Alemu et al. 2003)

Data of the outcome variable (cognitive achievement) was observed from round two while the data of the independent variables were accessed from both rounds. Cognitive achievement was measured when the index child is about five years old using the Peabody Picture Vocabulary Test (PPVT) and the Cognitive Developmental Assessment (CDA). These were administered to assess children's verbal and quantitative ability respectively in the younger cohort. According to Cueto et al. (2009), the former was originally developed by Dunn and Dunn in 1959 while the later is by International Evaluation Association (IEA). Cueto and his co-authors also revealed that these tests were administered after pilots of several cognitive development and achievement tests were carried out in each country prior to the data collection at round two. The

[9] Sentinel sites are chosen based on area coverage, balancing regional and ethnic differences, pro-poor bias, cost and convenience (remote areas excluded). After these sites are selected, data were collected using simple random sampling. Essentially, these 20 sites become the targets in each round of the survey.

PPVT test version administered in Ethiopia was version PPVT-III and Form-III A that contains 204 items arranged in order of increasing difficulty grouped into 17 sets and 12 items each. All the items were not administered to the given child rather only those items with in his/her critical range. That is, every child had a minimum (Basal Item Test) and maximum (Ceiling Item Test). The rule used to determine the former was to identify one or more errors in a set of 12 items while for the later is eight or more errors in a given set. The PPVT tests were norm-referenced with the aim of allowing comparison for variances between individuals. The CDA test had sub tests which includes spatial relations, quantity and time. However, it is mentioned that only the quantitative part was administered due to the reason that the time subscale were found to have low reliability and the spatial relations subscale took too long to administer as been observed by the pilot study. The quantitative part had 15 items and all were administered for each index child who took CDA test (Cueto et al. 2009).

Figure 2: Distribution of raw scores of PPVT test

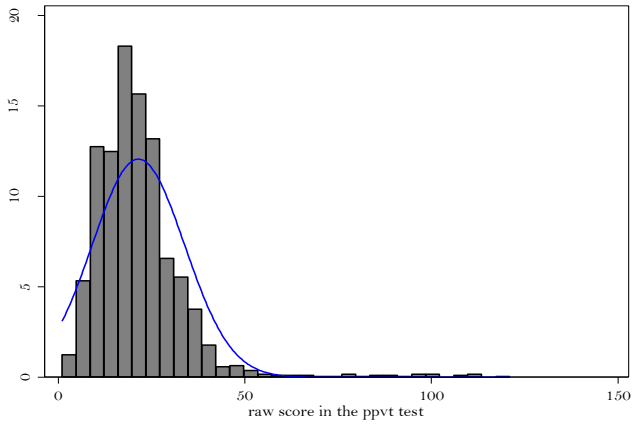
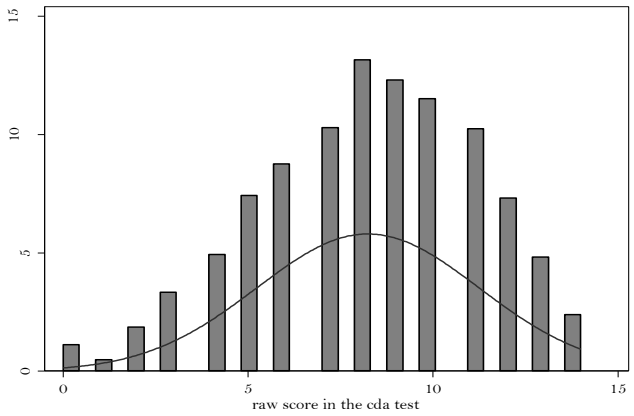


Figure 3: Distribution of raw scores of CDA test



On average, a child was asked to identify 51 items (based on the critical range) out of 204 items and answered about 21 items in the PPVT test with a standard deviation of 12.39. Of all the children who took the PPVT test, the minimum correct score was one while the maximum was 121. When the top 5% performers are removed, the range reduces from 1 to 39. In the CDA test,

each child was asked 15 questions on the quantity sub-test and the average correct score was 8.

Coming to the explanatory variable of interest, maternal depression was observed in round one (only) when the child was about one year old. It was proxied by observed caregiver's depression because more than 96 percent of caregivers were found to be biological mothers. Maternal depression is measured by transforming the self reported answers to 20 questions (SRQ20) about the care giver's status towards her mental health. This approach is recommended by World Health Organization. The care giver was asked 20 questions about self feelings towards unhappiness, tiredness, poor appetite, headache, poor sleep, etc[10] during the past 30 days. Each mental health (or depression) indicator is correlated with each other with the correlation coefficient ranging from 0.10 to 0.52. As can be seen from the table of correlation matrix below, for instance, there is very little correlation between feelings of handshake and trouble in thinking. Feelings of unhappiness and crying, however, have higher correlation.

Table 1: The correlation matrix among maternal mental health variables

	head-ache	*poorapp*	*Sleep*	*Fright*	*Hndshake*	*tense*	*Di-gestin*	*think*	*un-happy*	*cry*
head-ache	1.0									
Poorapp	0.35	1.0								
Sleep	0.29	0.31	1.0							
Fright	0.19	0.20	0.26	1.0						
Hndshake	0.15	0.14	0.22	0.20	1.0					
Tense	0.22	0.20	0.28	0.33	0.21	1.0				
Di-gestin	0.24	0.33	0.25	0.17	0.13	0.13	1.0			
Think	0.16	0.15	0.24	0.21	**0.10**	0.28	0.24	1.0		
un-happy	0.22	0.24	0.28	0.23	0.15	0.36	0.18	0.32	1.0	
Cry	0.17	0.19	0.19	0.23	0.12	0.31	0.16	0.28	**0.37**	1.0

	Enjoy	*Decision*	*work*	*Useful*	*lost*	*worth*	*ending*	*alltired*	*stomach*	*tired*
Enjoy	1.0									
Decision	0.41	1.0								
Work	0.21	0.14	1.0							
Useful	0.36	0.43	0.17	1.0						
Lost	0.35	0.36	0.18	0.43	1.00					
Worth	0.36	0.36	0.16	0.34	0.36	1.00				
Ending	0.35	0.37	0.15	0.39	0.33	**0.52**	1.0			
Alltired	0.28	0.26	0.15	0.26	0.25	0.28	0.29	1.0		

[10] The list of all items are attached in the appendix

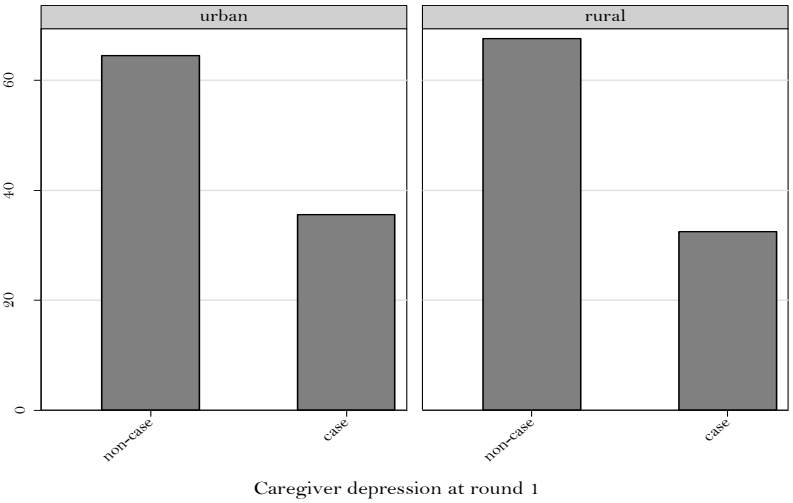
Stomach	0.21	0.22	**0.11**	0.17	0.20	0.19	0.25	0.35	1.0	
Tired	0.23	0.22	0.14	0.22	0.24	0.26	0.24	0.62	0.41	1.0

In the dataset, mothers are classified as 'case' and 'non-case' based on SRQ20 results. However, the decision about the cut of point, whether the depression status of the mother should be labelled as case or non-case, is a bit difficult because:

> "*…this involves a trade off between sensitivity (probability of the test identifying the case) and specificity (the instruments ability to identify true non cases). Increasing sensitivity inevitably causes some decreases in specificity. Conversely, increasing specificity decreases sensitivity. Some investigators prefer to be over inclusive, that is, accept the risk of having more false positives by lowering the cut off score- it is preferable to include false positives rather than to exclude false negatives. Cut off scores have been calculated (through the use of a gold standard) for various developing countries including Ethiopia and India. In India, typically seven yes's and above is regarded as a case. In Ethiopia the cut off score has generally been higher, for example ten/eleven. In countries where it is possible that no cut off score has been calculated for the SRQ20 (for example Vietnam) a small side study to test the SRQ20 against the "gold standard" of in depth psychiatric interview can determine the cut off point. Once the cut off point is identified, each respondent can be classified as case or non case of mental health and further analysis undertaken*" (Young Lives Justification Document)[11].

Based on this cut off point, about one third of the mothers' depression status was case without much difference between the rural and urban sample.

Figure 4: Depression status of care givers (mothers) by rural-urban category



[11] A document downloaded along with the data set

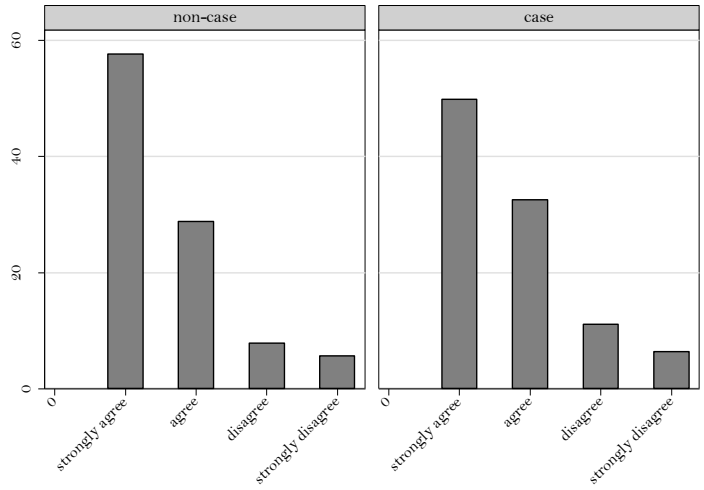
To avoid the problem that could arise due to adopting this arbitrary cut of point, a total score based on all the 20 items (SRQ20) is also used in the regression analysis.

Another variable of interest is maternal self-esteem (or self-efficacy). It depicts the attitude of a mother towards herself. The relevant questions that could serve to proxy this variable were observed unfortunately only in round two. Thus, each mother was asked whether she 'strongly agree', 'agree', 'disagree' or 'strongly disagree' to the following statements at round two of the survey. The question did not refer to any specific period rather was asked at a certain point in time regarding the general status of the mother with regard to the statements below.

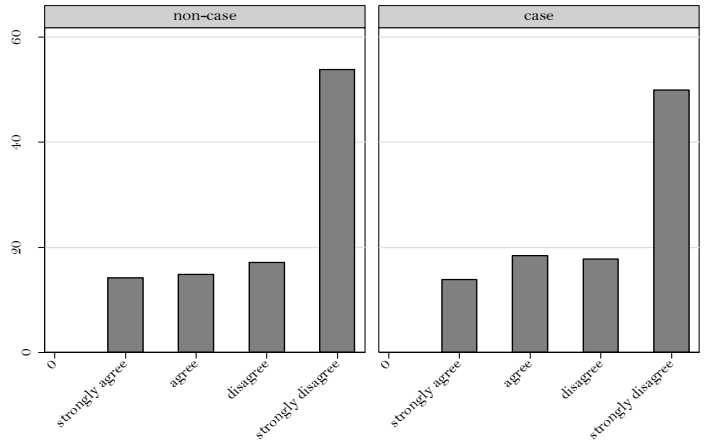
- I feel proud to show my friends or other visitors where I live. (+)
- I am ashamed of my clothes. (-)
- The job I do makes me feel proud. (+)
- I feel proud of my children. (+)

And each of these responses was coded ranging from +2 to -2 and then added up to give a total score. Finally, equivalent Z score was calculated based on this total score each mother has obtained. The histograms below show the percentage distribution of mothers' responses towards the above statements based on their postnatal depression status.

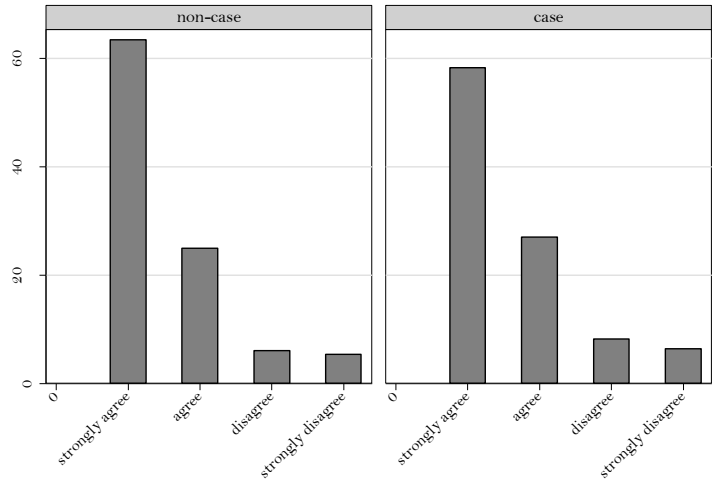
Figure 5: The distribution of maternal self-rating towards "I feel…items"



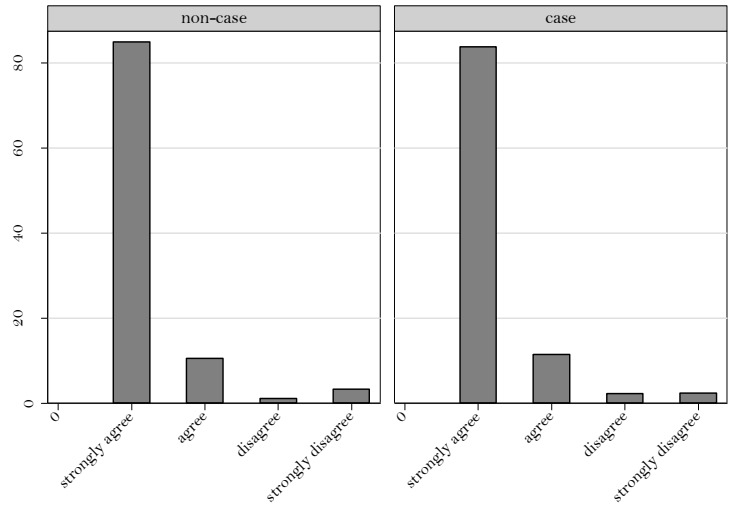
I feel proud to show my friends or other visitors where I live



I am ashamed of my clothes



The job I do makes me feel proud

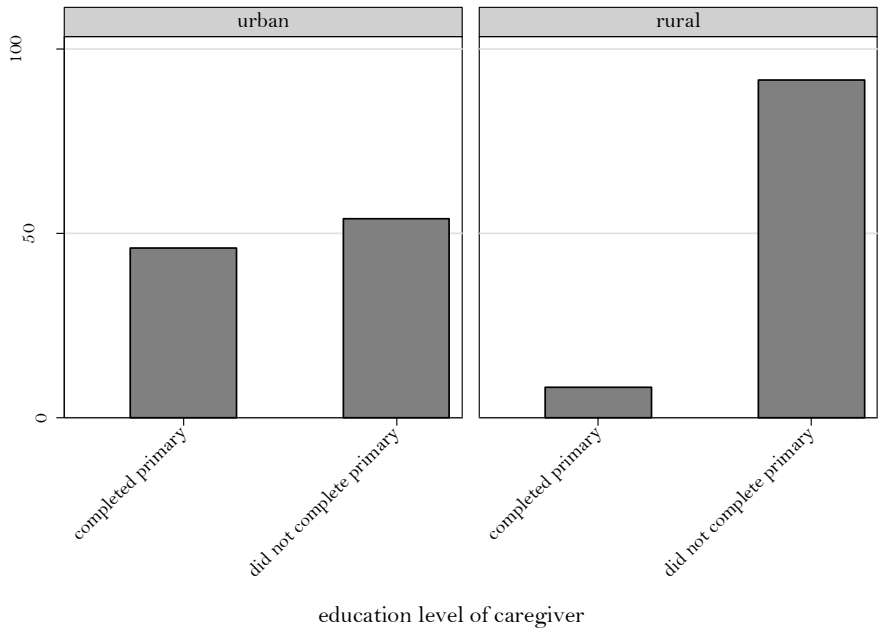


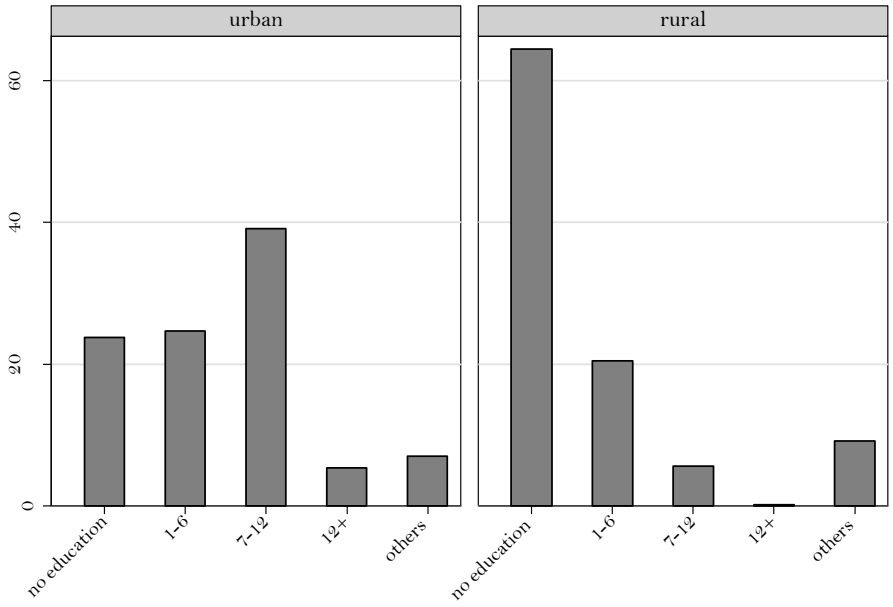
I feel proud of my children

As can be seen from the above graphs, there is no basic difference in terms of the indicators of self-esteem of the mother between mothers whose depression status is case and non-case. And nearly all of the mothers agree that they are proud of their children.

Another crucial variable worth mentioning here is education of the mother. Maternal education is observed in both rounds. In the first round, it is proxied by whether the caregiver completed primary school in round one. This is because in round one, more than 96% of the caregivers were biological mothers. In the second round, maternal education refers to whether the mother had some formal primary, secondary or tertiary education. It also includes other informal education like religious and adulthood education. In the final regression analysis, only round two data for maternal education is used since there is little variation in between the two rounds and due to the fact that maternal education at round two already captures information about round one.

Figure 6: The distribution of education status of the mothers in both rounds





In round one (2002), nearly half of the mothers did not complete primary school in urban areas while in rural areas less than 10% completed primary schooling. Four years later (in 2006), about 23% of the mothers had no any formal education while about 65% had at least some primary schooling in the urban areas. Similarly, in rural areas, nearly 65% of the mothers had no any education while a quarter of them have at least some level of primary schooling. Percentage of mother with tertiary education in both rural and urban samples is almost negligible with the least being in the rural areas.

3.2 Modelling cognitive achievement

To estimate the production of child's cognitive achievement, several authors have used various specifications. The variation in specifications could be due to the objective of the study and the nature of data that researchers could obtain. The vast multidisciplinary literature on cognitive development of children takes the view that determinants of cognitive development of children could be modelled using either of these approaches-the early childhood development (ECD) and the education production function (EPF). The former seeks to understand the role of parental characteristics and early home environment in producing cognitive skills while the latter study the productivity relationship between schooling inputs and test score outcomes for school age children (Todd and Wolpin 2003). This study follows the first approach because it is concerned about the effect of maternal depression when the children were age one, on their cognitive achievement at age five. It also tries to estimate the effect of maternal self-esteem on cognitive achievement of the child. Child cognitive achievement is measured by the Peabody Picture Vocabulary Test (PPVT) and the Cognitive Developmental Assessment (CDA). These were administered to assess children's verbal and quantitative ability respectively in

the younger cohort aged between 4.5 and 5.5 years old at the time of Round two. Both the PPVT and CDA tests are calculated in terms of raw scores. Equivalent z scores were calculated for the PPVT test for the sake of standardizing the test result since each child was not asked the same question.

The possible transmission mechanisms, by which maternal mental depression and self esteem could be translated in to cognitive achievement of their children, as explained earlier in the conceptual framework, could be via social (indirect) and biological (direct) mechanisms. If a mother compromises child care (like feeding) due to depression and low self-esteem, this could be translated into short-term or long-term nutritional deficiency of the child that could be observed by weight and height respectively. For this reason, first, the effect of maternal depression on child weight at year one and the effect of maternal depression and self esteem on height at year five shall be estimated using the following reduced form equations (1) and (2).

$$W_t = \beta.X_c + \beta_D.M_{Dt} + \mu \quad \text{.............................. (1)}$$

$$H_{t+4} = \beta.X_c + \beta_D.M_{Dt} + \beta_S M_{St+4} + \mu \quad \text{................ .(2)}$$

Where W_t refers to weight at year one; H_t refers to height at year five; M_{Dt} refers to maternal (postnatal) depression in year one while M_{St+4} refers to maternal self esteem in year five. X_c refers to a number of control variables. βs are parameters while μ refers to error terms.

Next, we estimate the effect of maternal depression and self esteem on cognitive achievement of children controlling for all possible covariates. In seeing the effect of maternal depression/mental health on cognitive achievement/mental development of children, different authors used different data sources and estimation techniques. For instance, Aboud and Alemu (1995) used Multiple Regression using Ordinary Least Square (OLS) estimates to predict the effect of nutrition and maternal responsiveness on children's Bayley scores. Cogill et al. (1986) used simple t test of significance difference and two way analysis of variance, while Caplan et al. (1989) used stepwise multiple-regression analysis[12] to show the added variation on BSQ scores of the child that comes from husband's psychiatric history, marital conflict in pregnancy and maternal depression when child aged four. Hay et al. (2001) also used Multiple Linear Regression to see if maternal postpartum depression at three months will affect children's IQ a decade later. A more recent study by Menash and Kierman (2010) used Tobit regression[13] to analyse the effect of parent's mental health on cognitive and emotional development of children.

---

[12] Stepwise regression is just a multiple regression in which variables are added to the regression equation one at a time by observing the statistical criteria of maximizing R^2. By doing so, it helps to find the most parsimonious set of predictors that are most effective in predicting the outcome variable.

[13] "The Tobit regression model estimates coefficients which represent the difference in the score attained by children in a particular category compared to children in the reference group, for example the difference between children whose mothers experi-

Another group of researchers like Kurstjens and Wolke (2001) and Murray et al. (1996) did a comparison of cognitive achievement of children whose mothers are depressed from that of the non-depressed ones. These studies randomly select a sub-sample from a given sample. However, as mentioned earlier, this may not ensure that depression is randomized due to the nature of the problem.

The current study essentially uses Multiple Linear Regression which is in practice same methodology to first group studies discussed above. It will estimate the reduced form equation three given below. However, this study uses several advantages: (1) Larger sample size with a wide socioeconomic, regional and rural-urban setting coverage as compared to some of the previous studies. (2) Minimum bias that could result from subjectivity of the teachers and mothers in rating behavioural and cognitive outcome of the index child. Moreover, one experimental study by Kicklighter et al. (1974), which investigated whether IQ scores obtained by children whose examiners are "naïve" from that of "experienced" examiners showed that there is no significant differences between these group of children. Thus, examiner's bias is very low. (3) Unique outcome variable (test of cognitive achievement) in that especially the PPVT test is advantageous over the other tests because of its objective scoring criteria and non-threatening nature even with the most fearful children (Kicklighter et al. 1974). (4) The ability to control for various potential confounding factors that most of the above mentioned studies failed to control for. Such factors include household wealth, paternal education, maternal height and child vaccination and nutrition, among others.

Thus, the final estimable equation would be the following reduced form.

$$A_{t+4} = \beta.X_c + \beta_D.M_{Dt} + \beta_S M_{St+4} + \mu \quad \text{…….....} \quad (3)$$

Where A_{t+4} refers for measure of cognitive achievement: z score in PPVT and raw score of CDA tests. All other variables as labelled previously.

3.3 Issues of potential bias

In estimating the effect of maternal mental health on the cognitive achievement of the child, there could be several ways that could bias the estimates. The first and primary problem most common in most econometric approaches is the presence of time invariant unobserved heterogeneity among children in terms of their innate ability. This could be solved if we had data of cognitive achievement at different time periods that allows to difference out the individual fixed effects, which unfortunately is not adopted in this study. Hence, it

---

enced high levels of psychological distress (7–24 points on the Kessler scale) and those experiencing very low levels (0–3 points on the Kessler scale)." -Menash and Kierman (2010).

should be noted that the regression results may underestimate the impact of depression or overestimate the effects of self-esteem.

Secondly, parent-child interaction or parenting quality could by itself be affected by child's cognitive ability. For instance, mothers could also be likely depressed as a result of seeing their child malnourished and having poor cognitive status. Difficult infant behaviours may affect a mother's depressive state, and thus breastfeeding may be compromised (Stewart et al. 2003). As put forward in the words of Paxson and Schady (2005), "*Economic models predict that parents adjust investments in "inputs" to child development in response to the perceived ability of the child. These investments could be "compensatory"—children with slow cognitive development could receive more and better food, or extra parental attention—or "complementary"—more resources could be devoted to the brightest children. In either case, associations between the measures of child health and parenting and test scores could in part be driven by parents' responses to their children's cognitive ability. Again, with only one cross-section of data it is not possible to determine whether this is so.*"

Thirdly, related to the above argument, mothers could also be more depressed or show signs of low self-esteem as a result of observing child behavioural problems and/or low level of achievement. This could significantly affect mother-child interaction. However, the fact that maternal depression is retrieved from round one while cognitive achievement is from round two may not at least worsen the problem. The assumption of past affects the future while the latter can not affect the former may hold true. But this remains problematic for the second variable-self-esteem since it is retrieved from round two. However, the percentage of mothers who did not (strongly) agree to the statement "I am proud of my children" is almost negligible. That is to mean, almost all mothers agree that they are proud of their children irrespective of their children's status of cognitive achievement.

Fourthly, another problem could arise from the survey questionnaire itself. It could be difficult to actually capture self-esteem with the statements used that are mentioned in section three. That is, there could be measurement error in calculating both self esteem and depression because mothers were shy to answer and interviewers were afraid to ask the indicators for self esteem and depression.

Fifthly, the increasing difficulty nature of the test and the fact that each child was not asked same items/questions on the PPVT test may bias the OLS estimates. To tackle this problem, the method used by Maluccio et al. (2009) in estimating the impact of early childhood nutrition on educational outcomes could be relevant. Accordingly, we can have additional specifications by respecifying the dependent variable by dividing the sample into quartiles based on the raw score. Based on this, marginal effects for probit results for those scoring in the top 75% or above, top 50% (median score) or above, and the top 25% (highest) performers can be reported and checked for consistency. Besides, estimation of the model in the presence of outliers could also lead for a bias. This could be the case when there are intellectually gifted (extreme

achievers in cognitive test) children. For this, the often used approach is to exclude the outliers if any from inclusion in the sample[14].

Lastly, the issue of measurement error could be a problem for instance when measuring height or weight of young children. However, this would be less likely correlated with the outcome variable. And hence measurement error is not going to be a serious problem. In addition, bias due to examiners or enumerators of the test is also supposed to be very low as discussed in the previous section. Issues of attrition could also be a source of bias but the attrition rate is 4.5% which is quite low.

Section IV: Results and Discussion

The first part of this section presents the descriptive results while the second part deals with the regression results.

4.1 Descriptive Results

First, we assess whether mean scores in the cognitive tests are different between children of mothers classified as 'depressed' and children of mothers classified 'non-depressed'. This will provide a clear and easy picture as to the whether a difference exits between these two groups of children.

When looking at the association between maternal depression and children's cognitive achievement, there is no significant difference in mean raw score of PPVT test between children of mothers classified as 'depressed' and children of mothers classified as 'non-case' in both the rural and urban sample. There is also no any mean difference between these two groups for both boys and girls as a whole and separately. The probability values for the t-tests are written in bold in tables 2 and 3.

Table 2: Mean raw score of children in the PPVT test based on maternal depression (case versus non-case)

Maternal depression status and sample category	*Mean raw score of PPVT test of the children based on sex*		
	Male	Female	Total
Urban sample			
Non-case	28.180	26.790	27.521
Case	28.696	24.886	26.957
t- test Pr(|T| > |t|)[15]	**0.7669**	**0.28861**	**0.6510**
Total	28.366	26.134	27.322
Rural sample			

[14] No difference is observed in the estimated results between full sample and sample excluding the outliers

[15] Pr(|T| > |t|) for Ha: diff = mean(non-case) - mean(case) is not equal to zero i.e., the larger the P value the less significant is the difference between the two.
H_0: diff = mean(non-case) - mean(case)=0

Non-case	18.976	17.288	18.167
Case	18.020	18.453	18.218
t-test Pr(|T| > |t|)	**0.2466**	**0.0969**	**0.9257**
Total	18.662	17.648	18.183
Total sample			
Non-case	22.16875	20.53675	21.38939
Case	22.07599	20.8917	21.53465
t-test Pr(|T| > |t|)	**0.9160**	**0.6716**	**0.8120**
Total	22.13725	20.65081	21.43747

Similarly, there is no significant difference in mean raw score of CDA test between children whose mother's depression is case and non-case in both the rural and urban sample for both boys and girls, separately, as well as altogether.

Table 3: Mean raw score of children in the CDA test based on maternal depression (case versus non-case)

maternal depression status and sample category	*Mean raw score of CDA test of the children based on sex*		
	male	female	Total
Urban sample			
Non-case	9.570	9.338	9.460
Case	9.881	9.415	9.668
t-test Pr(|T| > |t|)	**0.3240**	**0.8172**	**0.3629**
Total	9.682	9.365	9.534
Rural sample			
Non-case	7.489	7.536	7.512
Case	7.560	7.618	7.587
t-test Pr(|T| > |t|)	**0.7726**	**0.7509**	**0.6720**
Total	7.513	7.561	7.536
Total sample			
Non-case	8.205247	8.146712	8.177276
Case	8.438438	8.288732	8.36953
t-test Pr(|T| > |t|)	**0.2574**	**0.5056**	**0.1942**
Total	8.284404	8.192702	8.241119

4.2 Regression results

As explained in the conceptual frame work, maternal depression may affect child cognitive outcome (socially) indirectly through child-mother interaction. Depressed mothers may decrease breast feeding the child, compromise feeding and hygienic practices, and have less educational interaction with the child. However, it has been found from the data that 95% of the children were breast fed till the end of first year and there was little variation in the amount of months that the children were breastfed. Furthermore, 98% of the children are

seen by their mothers daily. This could serve as crude measure of emotional availability given the limitation of the data.

If maternal depression would have significant association with child cognitive development indirectly through feeding and hygienic issues which could be observed via nutritional effects, then we expect depression to have a negative and significant relationship with weight or height (or both weight and height) of children. For this reason, the first regression estimating the effect of maternal depression and self esteem on child weight and height is presented on Table 4A below. However, as can be seen from the table, no statistically significant relationship was found between maternal depression and either initial weight or height attained four years later. In addition, maternal self-esteem was not found to have significant association with height of children at year five. This finding is consistent with the results of Harpham et al. (2005), who found no clear relationship between high maternal CMD and poor child nutritional status in Ethiopia and Peru. Another more recent study by Hazarika (2010), which also used the same data set, did not find significant association between maternal mental health and child growth in India.

Table 4A: Effect of maternal depression on weight at year one and effect of maternal depression and self-esteem on height at year five

	(1)	(2)	(3)	(4)
	Weight at year one	Weight at year one	Height at year five	Height at year five
Maternal depression=case		0.028		0.322
		(0.700)		(0.228)
Maternal depression SRQ20 score	0.000		-0.005	
	(0.963)		(0.865)	
Maternal education	ref: did not complete primary			
Comp. primary school round 1	0.080	0.109		
	(0.358)	(0.211)		
Initial height			0.396***	0.397***
			(0.000)	(0.000)
[16]Maternal education: ref=no education				
Primary			0.664*	0.695**
			(0.064)	(0.047)
Secondary			1.510***	1.531***
			(0.004)	(0.003)
Tertiary			-0.090	0.122
			(0.926)	(0.900)

[16] Since maternal education is the key variable in affecting child outcome, we presented its coefficient in all the regression results along with variables of interest.

Religious/adult literacy			1.139**	1.082**
Observations	1388	1448	1382	1454
R-squared	0.267	0.262	0.310	0.315

…continued from table 4A

	(5) Height at year 5	(6) Height at year 5	(7) Height at year 5
Maternal self-esteem z score	0.053	0.055	0.048
	(0.714)	(0.718)	(0.747)
Maternal depression SRQ20 score		-0.004	
		(0.879)	
Maternal depression=case			0.324
			(0.228)
Initial height	0.402***	0.397***	0.399***
	(0.000)	(0.000)	(0.000)
Maternal education: ref=no education			
Primary	0.752**	0.692*	0.723**
	(0.031)	(0.054)	(0.040)
Secondary	1.512***	1.491***	1.514***
	(0.003)	(0.004)	(0.003)
Tertiary	-0.342	-0.565	-0.326
	(0.709)	(0.536)	(0.722)
Religious/adult literacy	1.037**	1.161**	1.105**
	(0.029)	(0.019)	(0.021)
Observations	1463	1372	1444
R-squared	0.314	0.311	0.316

Note: control variables include: child sex, age, birth order and BCG and measles vaccination, maternal height, paternal education, household head sex, household size, divorce, debt, wealth index, drought, regional and urban dummies. Robust p values in parentheses. * Significant at 10%; ** significant at 5%; *** significant at 1%.

When looking into the association of maternal depression and self-esteem with cognitive achievement of children separately (see tables 4B and 4C), we still see no significant relationship between depression and either PPVT or CDA tests even without controlling for various covariates. However, maternal self-esteem has a positive association with both tests. This association is initially insignificant in specifications 1 and 2 when there is no any control variables. However, in specifications 3 and 4, when more variables are controlled for, the association of self esteem and cognitive achievement becomes very strong. That is, both its significance and coefficient value keep on increasing when various child and household covariates are controlled for. Consider column 4 of the table 4C where all possible covariates are controlled. It is significant at 10.2% to be precise while it was at 12.3% in the 3rd specification (column 3) where initial weight and height as well as weight and height gain over 4 years were not controlled. Furthermore, it is significant even at 5% when considering specification 8 (column 8) of the same table. This indicates

that a 1% more deviation in the self-esteem of the mother from the mean self-esteem included in the sample is associated with a 0.15% increase in the raw score of the CDA test of the children. This coefficient is relatively bigger as compared to the effect on the PPVT test in specification four which is 0.044%.

Table 4B: Effect of maternal depression on cognitive achievement: Dependent variable z score of PPVT (specifications 1-4) and raw score of CDA (specifications 5-8) tests

	(1)	*(2)*	*(3)*	*(4)*
Maternal depression SRQ20 score	-0.005	-0.001	-0.001	-0.002
	(0.352)	(0.765)	(0.778)	(0.746)
Maternal education ref: no education				
Primary			0.125**	0.122**
			(0.016)	(0.026)
Secondary			0.455***	0.452***
			(0.000)	(0.000)
Tertiary			0.504*	0.514*
			(0.078)	(0.088)
Religious/adult literacy			0.020	0.007
			(0.782)	(0.926)
Observations	1734	1727	1380	1288
R-squared	0.001	0.257	0.293	0.302

…continued from table 4B

	(5)	*(6)*	*(7)*	*(8)*
Maternal depression SRQ20 score	0.003	0.016	0.020	0.018
	(0.850)	(0.259)	(0.206)	(0.289)
Maternal education ref: no education				
Primary			0.341	0.225
			(0.101)	(0.307)
Secondary			0.951***	0.764***
			(0.000)	(0.006)
Tertiary			0.740	0.541
			(0.185)	(0.332)
Religious/adult literacy			-0.001	-0.109
			(0.997)	(0.691)
Observations	1760	1752	1401	1308
R-squared	0.000	0.185	0.203	0.219

Table 4C: Effect of maternal self-esteem on cognitive achievement: Dependent variable z score of PPVT (specifications 1-4) and raw score of CDA (specifications 5-8) tests

	(1)	*(2)*	*(3)*	*(4)*
Maternal self-esteem z score	-0.002	0.019	0.039	0.044
	(0.946)	(0.381)	(0.123)	(0.102)
Maternal education ref: no education				
Primary			0.148***	0.137**
			(0.004)	(0.012)
Secondary			0.467***	0.460***
			(0.000)	(0.000)
Tertiary			0.474	0.476
			(0.107)	(0.124)
Religious/adult literacy			0.029	0.030
			(0.671)	(0.695)
Observations	1840	1831	1465	1350
R-squared	0.000	0.255	0.294	0.301

…continued from table 4C

	(5)	*(6)*	*(7)*	*(8)*
Maternal self-esteem z score	0.015	0.081	0.105	0.150**
	(0.837)	(0.222)	(0.157)	(0.049)
Maternal education ref: no education				
Primary			0.415**	0.244
			(0.041)	(0.255)
Secondary			1.006***	0.776***
			(0.000)	(0.004)
Tertiary			0.774	0.532
			(0.167)	(0.336)
Religious/adult literacy			0.058	0.038
			(0.819)	(0.888)
Observations	1867	1857	1487	1371
R-squared	0.000	0.182	0.198	0.220

Note: In 2 of the above tables (Tables 4B & 4C), Specification 1 includes no any control variable; 2-child sex & age, wealth index and regional differences; 3-maternal and paternal education, child vaccination, birth order, maternal height and age, household head sex, drought, divorce, debt, household size ; 4-initial height, initial weight, height gain, weight gain. Robust p values in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

Let us now turn on to the estimation results obtained where by both variables (depression and self-esteem) are entered in the regression at same

time. Here, the total score of SRQ20 as well as the "case-non case" classification of maternal depression is used. Still using both proxies of depression, there is no evidence that depression has significant association with both the PPVT and CDA tests. However, self-esteem of the mother significantly predicted scores on both of both PPVT and CDA tests at least at 10% level of significance after controlling all possible child, household, and regional covariates. In addition, the coefficient of this variable is both larger and more significant in the CDA test than in the PPVT test.

Our results are consistent with Kurstjens and Wolke (2001) and Murray et al. (1996), which found no significant effect of maternal depression on child's cognitive development from Germany and the UK. These two studies more or less used a comparison of depressed and control (non-depressed) groups while most of the literature cited adopted similar methods to the current study i.e., regression analysis.

Table 4D: Effect of maternal depression and self-esteem on cognitive achievement: Dependent variable z score of PPVT test for specifications (1) and (2) and raw score of CDA test for (3) and (4)

	(1)	*(2)*	*(3)*	*(4)*
Maternal depression SRQ20 score	-0.002		0.018	
	(0.776)		(0.272)	
Maternal depression=case[17]		0.011		0.195
		(0.819)		(0.224)
Maternal self-esteem z score[18]	0.046*	0.049*	0.158**	0.150**
	(0.098)	(0.071)	(0.042)	(0.049)
Maternal education ref: no education				
Primary	0.128**	0.131**	0.251	0.235
	(0.021)	(0.016)	(0.253)	(0.272)
Secondary	0.446***	0.441***	0.768***	0.782***
	(0.000)	(0.000)	(0.006)	(0.004)
Tertiary	0.538*	0.472	0.437	0.528

[17] Medhin et al. (2010) and Ross et al. (2011) used SRQ20 items but the cut off point for case versus non case they used was 6, unlike 11 in this study. For this reason, we also used the same cut off point as used by these authors and maternal depression was still found insignificant.

[18] To further investigate which part of the four self-esteem proxy variables is explaining the variation in child cognitive achievement, we separately run a regression for each of these variables by including all control variables. And it turns out that "I am ashamed of my clothes" was found the most significant while the rest were insignificant. This may indicate that the variable is capturing more of income/wealth than self-esteem. However, since factors like wealth and parental education are controlled, it could still explain self-esteem of the mother.

	(0.086)	(0.127)	(0.439)	(0.337)
Religious/ adult literacy	0.014	0.010	-0.076	-0.029
	(0.862)	(0.892)	(0.784)	(0.913)
Observations	1279	1338	1299	1359
R-squared	0.304	0.303	0.220	0.224

Note: control variables include: child sex, age, birth order and BCG and measles vaccination, maternal height, paternal education, household head sex, household size, divorce, debt, wealth index, drought, regional and urban dummies, initial height, initial weight, height gain, weight gain. Robust p values in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

All the above results depict that maternal depression does not have significant association with cognitive achievement of children. However, it may not be depression per se that is very important. It could be the duration, severity, or extent of depression that may matter more. To check these issues, we classified mothers based on their depression in to four categories from least depressed to highly depressed and compare the effect of highly depressed from those less depressed individuals. The result is presented in table 4E. Maternal depression still does not have significant association with cognitive achievement of children after controlling for various child, household, and regional differences. However, to further examine the issue of duration is hardly possible since the data on depression is collected only in round one.

Table 4E: Effect of maternal self-esteem and depression on cognitive achievement: Dependent variable z score of PPVT test for specifications (1) and (2) and raw score of CDA test for (3) and (4)

	(1)	*(2)*	*(3)*	*(4)*
Quartile rank based on depression (SRQ20) score: ref: least depressed (1st quartile)				
Less depressed (2nd quartile)	-0.260***	-0.096	-0.253	0.031
	(0.000)	(0.112)	(0.190)	(0.878)
Depressed (3rd quartile)	-0.197***	-0.088	-0.238	0.105
	(0.004)	(0.170)	(0.247)	(0.625)
Highly depressed **(**4th quartile**)**	-0.116	-0.011	-0.038	0.214
	(0.108)	(0.882)	(0.848)	(0.315)
Maternal self-esteem z score		0.048*		0.158**
		(0.082)		(0.042)
Maternal education ref: no education				
Primary		0.125**		0.249
		(0.024)		(0.258)
Secondary		0.447***		0.765***
		(0.000)		(0.006)
Tertiary		0.541*		0.427
		(0.081)		(0.450)
Religious/adult literacy		0.015		-0.073

		(0.850)		(0.791)
Observations	1734	1279	1760	1299
R-squared	0.010	0.306	0.001	0.220

Note: Specifications (1) and (3) have no any control variables while specifications (3) and (4) include: child sex, age, birth order and BCG and measles vaccination, maternal height, paternal education, household head sex, household size, divorce, debt, wealth index, drought, regional and urban dummies, initial height, initial weight, height gain, weight gain. Robust p values in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

Another significant variable that could be worth mentioning here might be maternal education. This variable was consistently significant in being positively associated with child nutritional status as well as cognitive achievement of children after controlling for all possible covariates. These could be due to several reasons. Previous researchers have given various mechanisms by which education of the mother could be significant in affecting child outcome. According to these authors, more educated mothers (1) may obtain more benefits from a given use of health services and demand for more health services (2) may have better perceptions about the best allocation of the inputs in the production of health (3) may be able to increase total family resources and also (4) may have knowledge and information that enable her to understand the interest of the child and hence respond accordingly towards the questions raised by the child in a manner that encourages the child interaction with her and improve verbal ability (Augustine and Crosnoe 2010, Glewwe 1999, Murnane et al. 1981, Parcel and Menaghan 1994, Rosenzweig et al. 1982, Rosenzweig and Wolpin 1994, Rubalcava and Teruel 2004).

4.3 Further Robustness Checks

The increasingly difficult nature of the test and the fact that each child was not asked same items/questions on the PPVT test may bias the OLS estimates. To further check for consistency, three additional specifications re-specifying the dependent variable by dividing the sample into quartiles based on the raw score are presented. Based on this, marginal effects for probit results for those scoring in the top 75% or above, top 50% (median score) or above, and the top 25% (highest) performers is reported in the next table. The results are presented in table 4F. Accordingly, it can be seen that maternal depression still remains insignificant. However, the self esteem of the mother remains to be quite significant in specifications (1) to (4). This may indicate that one more standard deviation improvement in maternal self-esteem is associated with about 3 and 4 percent increase in the probability of the child to be at the top 25% and top 50% of the children in the PPVT test.

Furthermore, another similar specification is presented in table 4G. In the first two specifications (1) and (2), dependent variable assumes one if the child's basal item lays in the top 50%, while in the rest of the specifications it assumes that the child's ceiling item lays in the top 25% and 50% in the PPVT test. According to this specification also, maternal depression failed to affect the probability of the child to be among the top 50% of his/her determined

basal item. In addition, neither did it predict the probability of the child to be in the top 25% or 50% of his/her ceiling item. However, maternal self-esteem positively predicted the child's probability of lying in the top 50% of his/her basal item and also the probability of being in the top 25% in his/her ceiling item.

Table 4F: Probit marginal effects of maternal depression and self-esteem on cognitive achievement: Dependent variable=1 if the child's score lies in the stated group of performers 0 otherwise in the PPVT test.

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	Top 25%	Top 25%	Top 50%	Top 50%	Top 75%	Top 75%
Maternal depression SRQ20 score	0.001		0.000		-0.003	
	(0.825)		(0.996)		(0.315)	
Maternal depression=case		0.012		0.033		-0.021
		(0.646)		(0.324)		(0.432)
Maternal self-esteem z score	0.028**	0.028**	0.040**	0.042***	0.009	0.009
	(0.033)	(0.028)	(0.016)	(0.009)	(0.477)	(0.483)
Maternal education ref: no education						
Primary	0.081**	0.084**	0.139***	0.135***	0.036	0.040
	(0.022)	(0.015)	(0.001)	(0.001)	(0.272)	(0.205)
Secondary	0.161***	0.169***	0.261***	0.251***	0.154***	0.156***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Tertiary	0.180*	0.142	0.274**	0.207	0.133	0.049
	(0.065)	(0.129)	(0.029)	(0.113)	(0.130)	(0.653)
Religious/adult literacy	-0.018	-0.023	0.050	0.057	-0.001	0.004
	(0.688)	(0.610)	(0.386)	(0.319)	(0.978)	(0.923)
Observations	1279	1338	1276	1335	1276	1335
Pseudo R2	0.2279	0.2332	0.1997	0.1990	0.1628	0.1582

Control variable include: child sex, age, birth order and BCG and measles vaccination, maternal height, paternal education, household head sex, household size, divorce, debt, wealth index, drought, regional and urban dummies, initial height, initial weight, height gain, weight gain. p values in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

Table 4G: Probit marginal effects of maternal depression and self-esteem on cognitive achievement: PPVT test

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	Top half	Top half	Top 25%	Top 25%	Top 50%	Top 50%
Maternal depression SRQ20 score	0.003		-0.001		-0.001	
	(0.209)		(0.579)		(0.788)	
Maternal depres-		0.017		-0.007		0.010

sion=case						
		(0.463)		(0.765)		(0.766)
Maternal self-esteem z score	0.028**	0.029***	0.020*	0.024**	0.017	0.020
	(0.013)	(0.007)	(0.077)	(0.039)	(0.301)	(0.210)
Maternal education ref: no education						
Primary	0.085***	0.080**	0.081**	0.081**	0.131***	0.123***
	(0.010)	(0.013)	(0.013)	(0.011)	(0.002)	(0.003)
Secondary	0.114**	0.109**	0.105**	0.113**	0.225***	0.219***
	(0.013)	(0.014)	(0.019)	(0.011)	(0.000)	(0.000)
Tertiary	0.387***	0.334***	0.217**	0.189**	0.115	0.064
	(0.000)	(0.001)	(0.022)	(0.036)	(0.326)	(0.578)
Religious/adult literacy	-0.058	-0.063	0.013	0.008	0.034	0.035
Observations	1290	1350	1290	1350	1290	1350
Pseudo R2	0.1606	0.1608	0.1953	0.1964	0.1767	0.1753

Note: For specifications (1) and (2), dependent variable assumes one if the child's basal item lays in the top 50% and 0 otherwise, for specifications 3-6, dependent variable assumes one if the child's ceiling item lays in the stated quartiles 0 otherwise in the PPVT test. All the control variables included in Table 4F are also included here. Notations of significance levels are also the same.

Section V: Concluding Remarks

The study used two waves of data of about 1300 children and their mothers to examine whether maternal depression during early life of the child (when the child is about one year old) could have lasting significant association with cognitive achievement of the child later at five years. It also investigates whether the relationship between self esteem of the mother and child's cognitive achievement is significant.

The results suggest that there is no evidence that maternal (postnatal) depression when the child is about one year old is associated with cognitive achievement of the child later at five years. In addition, maternal depression was also found to be insignificantly associated with child nutritional status. Specifically, we did not find evidence that maternal depression is associated with weight at an early age (age one) nor with height of the child achieved four years later. It might be difficult to infer causality due to: (1) the presence of time invariant unobserved heterogeneity among children in terms of their innate ability, and (2) problems related to endogeniety. However, the result that no association was found between maternal depression and cognitive achievement of children could possibly imply the following. (1) More direct biological and physiological pathways by which depression could be linked with child cognitive outcome seems not to work. (2) Although nearly one third of the mothers were found to be depressed, it might be the case that mothers were not constrained too large an extent to compromise child care. For instance about 95% of the children were breastfed. "*Ethiopian mothers often mention that their role is to feed and clean their child and not lose sight of it*" (Aboud and Alemu

1995). (3) It could also be the case that family networks collaborate a lot in caring the child in times the mother is depressed though there is no data to support this argument. But such a kind of custom or culture is usually visible in Ethiopia. There is evidence, for instance, by Gibson and Mace (2005) that in rural Ethiopian community, grandmothers had a positive effect on child survival and maternal grandmothers in particular had beneficial effect on child height.

The results also suggest that higher self-esteem of the mother was positively associated with the child cognitive achievement but not child nutritional status after controlling several covariates. This might imply that higher self-esteem is associated with positive mother-child interactions, such as more educational interactions that may lead to children's improved cognitive abilities.

However, like most studies, this study has its own limitations. These include: (1) the difficulty of controlling for differences in the innate ability of the child, (2) the endogeniety that could arise from the interaction of the mother with the child based on the child's cognitive achievement, and (3) the availability of limited data/information. For instance, presence of data on child-mother interaction, sufficient information on the duration, severity, extent of maternal depression might make the analysis strong. Despite all the limitations that the study might have suffered, it also dealt with the research question having used the advantages that could arise from (1) Larger sample size with a wide socioeconomic, regional and rural-urban setting coverage as compared to some of the previous studies. (2) Minimum bias that could result from subjectivity of the teachers and mothers in rating behavioural and cognitive outcome of the index child. Most of the studies in the literature, unlike this study, used measures of cognitive outcome rated by the teachers or parents. Also, examiner's bias is very low when one uses PPVT test (Kicklighter et al. 1974). (3) Unique outcome variable (test of cognitive achievement) in that especially the PPVT test is advantageous over the other tests because of its objective scoring criteria and non-threatening nature even with the most fearful children (Kicklighter et al. 1974). (4) The ability to control for various potential confounding factors that most of the previous studies failed to control for. Such factors include household wealth, paternal education, maternal height and child vaccination and nutrition, among others.

But in general, before arriving at a conclusion that maternal depression has negligible effect on cognitive achievement of children, it would be essential to conduct further research that could, for instance, use the third round of the Young Lives data set.

Appendices

Appendix 1: Literature review of some selected papers

Authors, Area, title	Menash and Kierman, 2010 England "Parent's mental health and children's cognitive and social development"	Paxson and Schady, 2007 Ecuador "Cognitive Development Among Young Children in Ecuador: The Roles of Wealth, Health and Parenting"	Kurstjens and Wolke, 2001 South Bavaria, Germany "Effect of maternal depression on cognitive development of children over the first 7 years of life"
Objective	the interplay between the mental health of parents and family socioeconomic resources, and the impact for children's cognitive and social development	Examining the role of SES, child health and parenting in cognitive development of children	Examine the effect of postnatal depression (severity, chronicity etc) on cognitive test scores at 20 months, 4 and 8 yrs (3 and 6 yrs)
Methods and measurements	-survey data from the Millennium Cohort study- areas of high rates of child poverty -mental health-Kessler 6 scale - children's achievement measured using Communication, language and literacy, Mathematical development and Personal, social and emotional development -estimation –tobit regression models and multivariate regression including gender interaction tests	- 3,153 children in 158 parishes in six provinces in Ecuador (rural and urban), young and poor families -children performance using TVIP - SES-wealth and parents education -child health and nutrition-Height-for-age and weight-for height z-scores, altitude-adjusted hemoglobin levels, and the number of months the child was breastfed parenting quality-HOME scale, an indicator for whether the child was read to in the week before the survey and number of other children in the household -estimation-OLS, MLH-probit, CLAD	-sample from Bavarian Longitudinal Survey (BLS) - stratification based on gender, SES, neonatal risk, and assessed at 6, 3 years of children - maternal psychiatric interview for 10 minutes in terms of timing, recency, severity, number, duration and severe chronically depressed group -for 20 months age-Griffiths Scales of Babies Abilities-DQ -at 4, 8 yrs-Columbian Mental Maturity Scale (CMM) -at 3, 6 yrs-Kaufman Assessment Battery for Children -group comparisons using three way univariate ANOVA

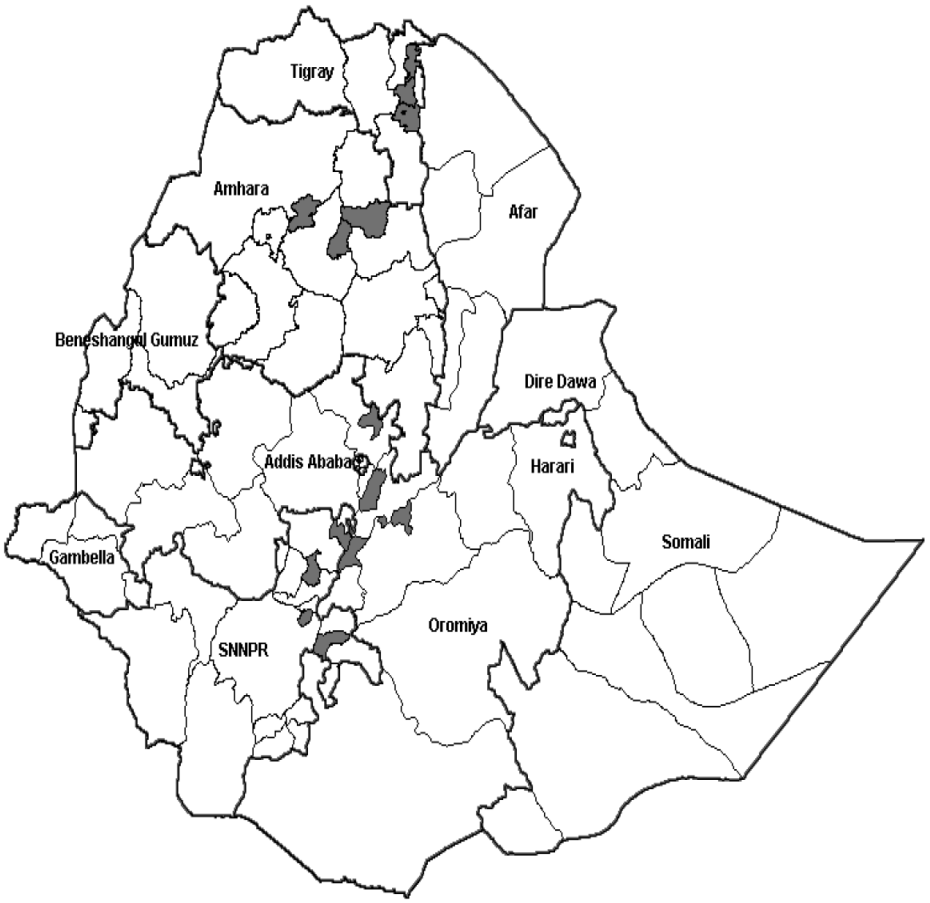
Results and key conclusions	-Lower attainment in all tests among children whose parents were experiencing high levels of psychological distress. -Parents' age and qualifications and families' socioeconomic resources strongly mediated the effects of parents' psychological distress on children's attainment -Stronger effects of mothers' mental health were found for boys than for girls - conclusion- close integration of mental health and social interventions to improve the well being of families	- censoring was not random (was associated with poor children and whose mothers are less educated -OLS resulted in a downward biased estimates - Children from wealthier households and with more educated parents have higher scores -parenting quality are associated with test scores, and mediate the association between SES and cognitive development -conclusion-focus on programs that raise household SES, improve child health and increase amount of cognitive stimulation children receive at home	- No significant effects of severity, timing of onset, duration, or chronicity of depression of the child's cognitive development were found -significant interactions of gender with chronicity of maternal depression (i.e. early-onset major and repeated episodes) were detected. -Low SES boys or boys born at neonatal risk of mothers with chronic depression had lower Achievement Scores in the K-ABC at 6; 3 years than children of mothers with less severe depression or controls. - Conclusion- maternal depression per se has negligible effects on children's cognitive development
Remarks	-larger sample -assessment was made by the child's teacher (decreases the bias of the parents) but still problem of subjectivity of the teacher -significance decreases as the model controls for various covariates like mother's age, income, etc - still lacks to control other covariates like nutrition	-larger sample -single cross sectional data -authors doubt on causality issues -single outcome variable-only TVIP	-difficulty of randomizing depression -though randomized between control and experimental groups, there could be still biases as a result of various covariates

Authors, Area, title	Murray et al, 1996 UK "The Cognitive Development of 5-Year-Old Children of Postnatally Depressed Mothers"	Hay et al, 2001 London "Intellectual Problems Shown by 11-year-old Children Whose Mothers Had Postnatal Depression"
Objective	-to determine whether the influences of early maternal depression and mother-infant interactions on 18-month cognitive functioning remained when the children were 5 years old	-to examine long-term consequence in the children of mothers who were depressed at 3 months postpartum
Methods and measurements	-a random sample of depressed and non-depressed mothers and their children -follow up at 2 and 18 months, 5 years -Edinburgh Postnatal Depression Scale (EPDS) -used for maternal depression -two months face to face interactions -cognitive tests-at 18 months tasks of object permanence and the Bayley Scales of Mental Development and at 5 years, the McCarthy Scales of Children's Abilities -comparison of control and experimental groups	- Randomly selected sample of women from participants in an ongoing, prospective longitudinal study of child development in two communities -highly representative of urban populations in contemporary Britain. –psychiatric interviews at 3 months postpartum and -various IQ, mathematical tests at 11 years for the children - Multiple linear regression was used to model the relationship between the primary dependent variable, child's IQ measured at 11 years, and postnatal depression, along with potential mediating variables
Results and key conclusion	- no evidence of an adverse effect of postnatal depression, even amongst sub-groups of children suggested to be vulnerable (boys and children from low SES families) -but, the more actively the infant was engaged in communication with the mother the better the cognitive performance -the way in which the mother engages with the infant in the postpartum months comes to influence the general nature of infant cognitive performance	- children of depressed women at 3 months postpartum had significantly lower IQ scores, attention problems and difficulties in mathematical reasoning, and were more likely than other children to have special educational needs -Boys were more severely affected than girls, especially in Performance IQ -adverse experiences in infancy predict cognitive ability and academic performance a decade later.
Remarks	-difficulty of randomizing depression -Needs an explicit examination of depressed mothers and their interaction with their children.	-difficulty of randomizing depression -assessment by the teacher -no control for various covariates like nutritional status of the child

Appendix 2: Description of maternal mental health variables

No	*Variable*	*Description*	*%=Yes*
1	headache	Did you often have headaches?	54
2	poorapp	Was your appetite poor?	31
3	Sleep	Did you sleep badly?	30
4	fright	Were you easily frightened?	23
5	hndshake	Did you hands shake?	09
6	Tense	Did you feel nervous, tense or worried?	31
7	digestin	Was your digestion poor?	28
8	think	Did you have trouble thinking clearly?	27
9	unhappy	Did you feel unhappy?	39
10	Cry	Did you cry more than usual?	21
11	enjoy	Did you find it difficult to enjoy your daily activities?	27
12	decision	Did you find it difficult to make decisions?	24
13	Work	Did your daily work suffer?	39
14	useful	Were you unable to play a useful part in life?	21
15	Lost	Did you lose interest in things?	26
16	worth	Did you feel you were a worthless person?	25
17	ending	Were things so bad that you felt that you just couldn't go on?	22
18	alltired	Did you feel tired all of the time?	42
19	stomach	Did you have uncomfortable feelings in your stomach?	32
20	tired	Were you easily tired?	45

Appendix 3: Map of Ethiopia showing Weredas /districts containing sentinel sites, taken from Alemu et al. (2003).



Bibliography

1. Abbott, R.D., L.R. White, G.W. Ross, H. Petrovitch, K.H. Masaki, D.A. Snowdon et al. (1998) 'Height as a Marker of Childhood Development and Late-Life Cognitive Function: The Honolulu–Asia Aging Study', *Pediatrics* 102(3): 602.
2. Aber, J.L., N.G. Bennett, D.C. Conley and J. Li (1997) 'The Effects of Poverty on Child Health and Development', *Annual Review of Public Health* 18(1): 463-483.
3. Abood, D.A. and T.L. Conway (1992) 'Health Value and Self-Esteem as Predictors of Wellness Behavior.', *Health Values: The Journal of Health Behavior, Education & Promotion* 16(3): 20-26.
4. Aboud, F.E. and T. Alemu (1995) 'Nutrition, Maternal Responsiveness and Mental Development of Ethiopian Children', *Social science & medicine* 41(5): 725-732.
5. Alemu, T., G. Asgedom, J. Liebenberg, A. Mekonnen, J. Seager, B. Tefera et al. (2003) 'Young Lives Preliminary Country Report: Ethiopia.'.
6. Augustine, J.M. and R. Crosnoe (2010) 'Mothers' Depression and Educational Attainment and their Children's Academic Trajectories', *Journal of health and social behavior* 51(3): 274.
7. Baharudin, R. and T. Luster (1998) 'Factors Related to the Quality of the Home Environment and Children's Achievement', *Journal of Family Issues* 19(4): 375.
8. Baumeister, R.F., J.D. Campbell, J.I. Krueger and K.D. Vohs (2003) 'Does High self - esteem Cause Better Performance, Interpersonal Success, Happiness, Or Healthier Lifestyles?', *Psychological science in the public interest* 4(1): 1-44.
9. Behrman, J.R. and M.R. Rosenzweig (2002) 'Does Increasing Women's Schooling Raise the Schooling of the Next Generation?', *The American Economic Review* 92(1): 323-334.
10. Bettes, B.A. (1988) 'Maternal Depression and Motherese: Temporal and Intonational Features', *Child development* : 1089-1096.
11. Bing, E. (1963) 'Effect of Childrearing Practices on Development of Differential Cognitive Abilities', *Child development* 34(3): 631-648.
12. Black, S., P.J. Devereux and K. Salvanes (2003) , *Why the apple doesn't fall far: Understanding intergenerational transmission of human capital* .
13. Bradley, R.H. and R.F. Corwyn (2002) 'Socioeconomic Status and Child Development', *Annual Review of Psychology* 53(1): 371-399.
14. Brennan, L., J. McDonald and R. Shlomowitz (1997) 'Sex Differences in Indian Height at Home and Abroad', *Man in India* 77(2-3): 105-118.
15. Brennan, P.A., C. Hammen, M.J. Andersen, W. Bor, J.M. Najman and G.M. Williams (2000) 'Chronicity, Severity, and Timing of Maternal Depressive Symptoms: Relationships with Child Outcomes at Age 5.', *Developmental psychology* 36(6): 759.
16. Cogill, S., H. Caplan, H. Alexandra, K.M. Robson and R. Kumar (1986) 'Impact of Maternal Postnatal Depression on Cognitive Development

of Young Children.', *British medical journal (Clinical research ed.)* 292(6529): 1165.
17. Coleman, P.K. and K.H. Karraker (1998) 'Self-Efficacy and Parenting Quality: Findings and Future Applications* 1,* 2', *Developmental Review* 18(1): 47-85.
18. Coleman, P.K. and K.H. Karraker (2003) 'Maternal self-efficacy Beliefs, Competence in Parenting, and Toddlers' Behavior and Developmental Status', *Infant Mental Health Journal* 24(2): 126-148.
19. Creswell, J.D., W.T. Welch, S.E. Taylor, D.K. Sherman, T.L. Gruenewald and T. Mann (2005) 'Affirmation of Personal Values Buffers Neuroendocrine and Psychological Stress Responses', *Psychological Science* 16(11): 846.
20. Cueto, S., J. Leon, G. Guerrero and I. Munoz (2009) 'Psychometric Characteristics of Cognitive Development and Achievement Instruments in Round 2 of Young Lives', *Young Lives Technical Note* 15.
21. Cummings, E.M. and P.T. Davies (1994) 'Maternal Depression and Child Development', *Journal of Child Psychology and Psychiatry* 35(1): 73-122.
22. Denny, K. and O. Doyle (2010) 'The Causal Effect of Breastfeeding on children's Cognitive Development: A Quasi-Experimental Design', *Working Papers* .
23. Dercon, S. and J. Hoddinott (2004) '6. Health, Shocks, and Poverty Persistence', *Insurance against poverty* 1(9): 124-137.
24. Fedorov, L. and D.E. Sahn (2005) 'Socioeconomic Determinants of Children's Health in Russia: A Longitudinal Study', *Economic Development and Cultural Change* 53(2): 479-500.
25. Felson, R.B. (1984) 'The Effect of Self-Appraisals of Ability on Academic Performance.', *Journal of personality and social psychology* 47(5): 944.
26. Felson, R.B. (1981) 'Ambiguity and Bias in the Self-Concept', *Social psychology quarterly* : 64-69.
27. Field, T. (1995) 'Infants of Depressed Mothers.', *Infant behavior & development* .
28. Field, T., B.T. Healy, S. Goldstein and M. Guthertz (1990) 'Behavior-State Matching and Synchrony in Mother-Infant Interactions of Nondepressed Versus Depressed Dyads.', *Developmental psychology* 26(1): 7.
29. Field, T.M. (1984) 'Early Interactions between Infants and their Postpartum Depressed Mothers.', *Infant Behavior & Development* .
30. Ford, R., T. Maynard and N. Thomas (2010) 'Thinking and Cognitive Development in Young Children', *An introduction to early childhood studies* : 66–78.
31. Foreman, D.M. (1998) 'Maternal Mental Illness and Mother-Child Relations', *Advances in Psychiatric Treatment* 4(3): 135.
32. Frank, R.G. and T.G. McGuire (2000) 'Economics and Mental Health', *Handbook of health economics* 1: 893-954.
33. Gibson, M.A. and R. Mace (2005) 'Helpful Grandmothers in Rural Ethiopia: A Study of the Effect of Kin on Child Survival and Growth', *Evolution and Human Behavior* 26(6): 469-482

34. Ghodsian, M., E. Zajicek and S. Wolkind (1984) 'A Longitudinal Study of Maternal Depression and Child Behaviour Problems', *Journal of Child Psychology and Psychiatry* 25(1): 91-109.
35. Glewwe, P. (1999) 'Why does Mother's Schooling Raise Child Health in Developing Countries? Evidence from Morocco', *Journal of human resources* : 124-159.
36. Goodman, S.H. (2007) 'Depression in Mothers', *Annu.Rev.Clin.Psychol.* 3: 107-135.
37. Goodman, S.H., D.R. Sewell, E.L. Cooley and N. Leavitt (1993) 'Assessing Levels of Adaptive Functioning: The Role Functioning Scale', *Community mental health journal* 29(2): 119-131.
38. Goswami, U. (2004) 'Blackwell Handbook of Childhood Cognitive Development', 'Blackwell Handbook of Childhood Cognitive Development', Wiley Online Library.
39. Grantham-McGregor, S., Y.B. Cheung, S. Cueto, P. Glewwe, L. Richter and B. Strupp (2007) 'Developmental Potential in the First 5 Years for Children in Developing Countries', *The Lancet* 369(9555): 60-70.
40. Greenough, W.T., J.E. Black and C.S. Wallace (1987) 'Experience and Brain Development', *Brain Dovelopement and Cognition* : 186-216.
41. Haden, A. and B. Campanini (2001) *The World Health Report 2001: Mental Health: New Understanding, New Hope*. World health organization (WHO).
42. Harpham, T., S. Huttly, M.J. De Silva and T. Abramsky (2005) 'Maternal Mental Health and Child Nutritional Status in Four Developing Countries', *Journal of epidemiology and community health* 59(12): 1060.
43. Hay, D.F., S. Pawlby, D. Sharp, P. Asten, A. Mills and R. Kumar (2001) 'Intellectual Problems shown by 11 - year - old Children Whose Mothers had Postnatal Depression', *Journal of Child Psychology and Psychiatry* 42(7): 871-889.
44. Hazarika, A. (2010) 'The Effect of Maternal Education and Maternal Mental Health on Child's Growth'.
45. Hoddinott, J. and B. Kinsey (2001) 'Child Growth in the Time of Drought', *Oxford Bulletin of Economics and Statistics* 63(4): 409-436.
46. Holme, A., C. MacArthur and R. Lancashire (2010) 'The Effects of Breastfeeding on Cognitive and Neurological Development of Children at 9 Years', *Child: Care, Health and Development* 36(4): 583-590.
47. Jiang, M., E.M. Foster and C.M. Gibson-Davis (2010) 'Breastfeeding and the Child Cognitive Outcomes: A Propensity Score Matching Approach', *Maternal and child health journal* : 1-12.
48. Kicklighter, R.H., J. Powell and J. Parker (1974) 'The Peabody Picture Vocabulary Test and Naive Versus Trained Examiners', *The Journal of Experimental Educational* : 27-29.
49. Kiff, C.J., L.J. Lengua and M. Zalewski 'Nature and Nurturing: Parenting in the Context of Child Temperament', *Clinical child and family psychology review* : 1-51.
50. Kliegman, R. (2007) *Nelson Textbook of Pediatrics*. Saunders.

51. Knitzer, J., S. Theberge and K. Johnson (2008) 'Reducing Maternal Depression & its Impact on Young Children', *National Center for Children in Poverty, Columbia University School of Public Health Jan* .
52. Kurstjens, S. and D. Wolke (2001) 'Effects of Maternal Depression on Cognitive Development of Children Over the First 7 Years of Life', *Journal of Child Psychology and Psychiatry* 42(5): 623-636.
53. Livingood, A.B., P. Daen and B.D. Smith (1983) 'The Depressed Mother as a Source of Stimulation for Her Infant', *Journal of clinical psychology* 39(3): 369-375.
54. Lucas, A. (1998) 'Programming by Early Nutrition: An Experimental Approach', *The Journal of nutrition* 128(2): 401S.
55. Maluccio, J.A., J. Hoddinott, J.R. Behrman, R. Martorell, A.R. Quisumbing and A.D. Stein (2009) 'The Impact of Improving Nutrition during Early Childhood on Education among Guatemalan Adults', *Economic Journal* 119(537): 734-763.
56. Mary A., S. (2011) 'The Intergenerational Effects of Parental Schooling on the Cognitive and Non-Cognitive Development of Children', *Economics of Education Review* 30(2): 258-268.
57. Maynard, T. and N. Thomas (2004) *An Introduction to Early Childhood Studies*. Sage Publications Ltd.
58. Meadows, S.O., S.S. McLanahan and J. Brooks - Gunn (2007) 'Parental Depression and Anxiety and Early Childhood Behavior Problems Across Family Types', *Journal of Marriage and Family* 69(5): 1162-1177.
59. Medhin, G., C. Hanlon, M. Dewey, A. Alem, F. Tesfaye, Z. Lakew et al. (2010) 'The Effect of Maternal Common Mental Disorders on Infant Undernutrition in Butajira, Ethiopia: The P-MaMiE Study', *BMC psychiatry* 10(1): 32.
60. Mensah, F.K. and K.E. Kiernan (2010) 'Parents' Mental Health and children's Cognitive and Social Development', *Social psychiatry and psychiatric epidemiology* : 1-13.
61. Minor, F. (1973) 'Cognitive Development: Some Pervasive Issues', *Theory into Practice* 12(2): 78-87.
62. Mitchell, D.K., S.K. Adams and K.K. Murdock (2005) 'Associations among Risk Factors, Individual Resources, and Indices of School - Related Asthma Morbidity in Urban, School - Aged Children: A Pilot Study', *Journal of school health* 75(10): 375-383.
63. Mulatu, M.S. (1995) 'Prevalence and Risk Factors of Psychopathology in Ethiopian Children', *Journal of the American Academy of Child & Adolescent Psychiatry* 34(1): 100-109.
64. Murnane, R.J., R.A. Maynard and J.C. Ohls (1981) 'Home Resources and Children's Achievement', *The review of economics and statistics* 63(3): 369-377.
65. Murray, L., A. Hipwell, R. Hooper and A. Stein (1996) 'The Cognitive Development of 5-Year-Old Children of Postnatally Depressed Mothers.', *Journal of Child Psychology and Psychiatry* .
66. Nelson, C.A. and F.E. Bloom (1997) 'Child Development and Neuroscience', *Child development* 68(5): 970-987.

67. Outes-Leon, I. and A. Sanchez (2008) 'An Assessment of the Young Lives Sampling Approach in Ethiopia', *Young Lives Technical Note* 1.
68. Parcel, T.L. and E.G. Menaghan (1994) 'Early Parental Work, Family Social Capital, and Early Childhood Outcomes', *American Journal of Sociology* : 972-1009.
69. Patel, V., A. Rahman, K. Jacob and M. Hughes (2004) 'Effect of Maternal Mental Health on Infant Growth in Low Income Countries: New Evidence from South Asia', *Bmj* 328(7443): 820.
70. Paxson, C. and N. Schady (2005) 'Cognitive Development among Young Children in Ecuador: The Roles of Wealth, Health, and Parenting', *World Bank Policy Research Working Paper No.3605* .
71. Plug, E. and W. Vijverberg (2003) 'Schooling, Family Background, and Adoption: Is it Nature Or is it Nurture?', *Journal of Political Economy* 111(3): 611-641.
72. Rosenzweig, M.R. and T.P. Schultz (1982) 'Child Mortality and Fertility in Colombia: Individual and Community Effects* 1', *Health policy and education* 2(3-4): 305-348.
73. Rosenzweig, M.R. and K.I. Wolpin (1994) 'Are there Increasing Returns to the Intergenerational Production of Human Capital? Maternal Schooling and Child Intellectual Achievement', *Journal of Human Resources* : 670-693.
74. Ross, J., C. Hanlon, G. Medhin, A. Alem, F. Tesfaye, B. Worku et al. (2011) 'Perinatal Mental Distress and Infant Morbidity in Ethiopia: A Cohort Study', *Archives of disease in childhood.Fetal and neonatal edition* 96(1): F59.
75. Rubalcava, L.N. and G.M. Teruel (2004) 'The Role of Maternal Cognitive Ability on Child Health', *Economics & Human Biology* 2(3): 439-455.
76. Ruel, M.T., J. Rivera, J.P. HABICHT and R. Martorell (1995) 'Differential Response to Early Nutrition Supplementation: Long-Term Effects on Height at Adolescence', *International journal of epidemiology* 24(2): 404.
77. Rutter, M. (1985) 'Family and School Influences on Cognitive Development', *Journal of Child Psychology and Psychiatry* 26(5): 683-704.
78. Sohr-Preston, S.L. and L.V. Scaramella (2006) 'Implications of Timing of Maternal Depressive Symptoms for Early Cognitive and Language Development', *Clinical child and family psychology review* 9(1): 65-83.
79. Stein, A., D.H. Gath, J. Bucher, A. Bond, A. Day and P. Cooper (1991) 'The Relationship between Post-Natal Depression and Mother-Child Interaction', *The British Journal of Psychiatry* 158(1): 46.
80. Stewart, D.E., E. Robertson, C.L. Dennis, S.L. Grace and T. Wallington (2003) 'Postpartum Depression: Literature Review of Risk Factors and Interventions', *Toronto: University Health Network Women's Health Program for Toronto Public Health.*
81. Stiles, J. and T.L. Jernigan (2010) 'The Basics of Brain Development', *Neuropsychology review* : 1-22.
82. Strauss, J. and D. Thomas (1998) 'Health, Nutrition, and Economic Development', *Journal of economic literature* 36(2): 766-817.

83. Surkan, P.J., L. Schnaas, R.J. Wright, M.M. Téllez-Rojo, H. Lamadrid-Figueroa, H. Hu et al. (2008) 'Maternal Self-Esteem, Exposure to Lead, and Child Neurodevelopment', *Neurotoxicology* 29(2): 278-285.
84. Taylor, S.E. and J.D. Brown (1988) 'Illusion and Well-being: A Social Psychological Perspective on Mental Health.', *Psychological bulletin* 103(2): 193.
85. Thomas, D. (1994) 'Like Father, Like Son; Like Mother, Like Daughter: Parental Resources and Child Height', *Journal of Human Resources* : 950-988.
86. Todd, P.E. and K.I. Wolpin (2003) 'On the Specification and Estimation of the Production Function for Cognitive Achievement*', *The Economic Journal* 113(485): F3-F33.
87. Torres, R. and F. Fernandez (1995) 'Self-Esteem and Value of Health as Determinants of Adolescent Health Behavior', *Journal of adolescent health* 16(1): 60-63.
88. Weissman, M.M., P. Wickramaratne, Y. Nomura, V. Warner, D. Pilowsky and H. Verdeli (2006) 'Offspring of Depressed Parents: 20 Years Later', *American Journal of Psychiatry* 163(6): 1001.
89. WHO Multicentre Growth Reference Study Group (2006) 'WHO Child Growth Standards:: Length/height-for-Age, Weight-for-Age, Weight-for-Length, Weight-for-Height and Body Mass Index-for-Age: Methods and Development.'.
90. Woldehanna, T., A. Mekonnen and T. Alemu (2008) 'Young Lives: Ethiopia Round 2 Survey Report', *Young Lives Country Report, Oxford: Young Lives* .
91. World Bank (1993) *World Development Report 1993. Investing in Health: World Development Indicators.* Oxford University Press.
92. Yamano, T., H. Alderman and L. Christiaensen (2005) 'Child Growth, Shocks, and Food Aid in Rural Ethiopia', *American Journal of Agricultural Economics* : 273-288.