INFANT RECOGNITION MEMORY AND PHYSICAL GROWTH IN WOLAYITA: RELATIONS TO MATERNAL DEPRESSION, FOOD INSECURITY SOCIAL SUPPORT AND MOTHER-INFANT INTERACTION

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CHAPTER I

INTRODUCTION

1.1. Background to the problem

A large number of children living in disadvantaged environments fail to reach their physical, cognitive and social–emotional potentials. According to Grantham-McGregor and associates in 2007, more than 550 million children under age of 5 years lived in developing countries and, of these, 126 million children lived in absolute poverty (below the poverty line, the level to afford minimal amount of requirements to survive such as food, clothing, shelter and health care) and 39% fail to reach their physical, cognitive and social potential (Grantham-McGregor et al., 2007). The situation for infants and children in Ethiopia, a country classified as one of the top 10 countries of the world in which the most disadvantaged children live (Grantham-McGregor et al., 2007), is worse than many others countries of the world. Research has documented various risk factors that may prevent children from attaining their potentials, and some of these factors are maternal depression and stress, low maternal education status, poverty, and poverty-related factors such as low family income and poor nutrition (Wachs, Black, & Engle, 2009).

Mothers are the primary caregivers of infants and any factor that threatens maternal health might adversely affect their infants' growth and development. Studies

show that maternal depression is a worldwide problem that affects about 6-16% of mothers in high-income countries (Grote et al., 2010) and about 9.4 - 34% of mothers in low income countries (Ndokera & MacArthur, 2010). Moreover, some researchers concluded that the prevalence rate of maternal depression and stress is 3 times more common in low-income countries than in high-income countries, and a pattern of its high prevalence is increasing in low-income countries because of increasing poverty and deteriorating economic status (inadequate housing and rising unemployment), early marriages, unplanned pregnancy which occurs as the result of forced intercourse, marital discord, and high rate of maternal illiteracy, (Patel, DeSouza & Rodriues, 2003; WHO, 2007).

Maternal depression and infant weight and length

Maternal depression includes feelings of sadness, hopelessness, fatigue, changes in sleep patterns and sometimes suicidal thoughts (Cox, Chapman, Murray, & Jones, 1996; Cox, Holden, & Sagovsky, 1987). Depression is one of the major sources of disability among mothers worldwide, particularly among mothers in low-income countries (Prince et al., 2007; Rahman, Patel, Maselko, & Kirkwood, 2008). A growing number of studies have indicated that the prevalence of maternal depression in low-income countries may be at least twice that of industrialized countries (Chiband et al., 2010; Cooper et al., 1999; Fisher et al., 2010; Harpham et al., 2005; Patel et al., 2004; Tran et al., 2011). Maternal depression is getting public attention as a major health problem because its adverse effect is not limited to mothers but also affects their infants who are completely dependent upon them. Measurement of maternal depression will be discussed at length in chapter 3. However, it is important to note here that in Ethiopia, the location of the current dissertation project, maternal depression has

been measured by Edinburg Postnatal Depression Scale (EPDS: Cox, Holden, & Sagovisky, 1987).

Infant weight and length are important global indicators of infant well-being and survival because both infant infection and poor nutrition can be reflected by these anthropometric indices (Gibson et al., 2009; Parsons et al., 2012; Saha et al., 2009). Black, Morris, and Bryce (2003) indicated that about 53% of infant death is attributed to underweight. Evidence further shows that poor growth is a major problem in low-income countries. For example, the analysis of a large representative sample drawn from 39 low-income countries of the world showed that poor linear growth starts shortly after birth and poor weight change takes place starting at the 3rd month of life (Shrimpton et al., 2001). About 220 million children under age 5 years living in low-income countries have been suffering from impaired growth, and specifically, about 112 million are underweight and 178 million are stunted (Black et al., 2008). It is well documented that poor growth in the early formative years has detrimental effects on later child health and development in the developing world (Mustard, 2006). However, currently far less is known about the impact of interactions among economic, nutritional, and maternal psychosocial risk factors on infant growth and cognitive development (Parsons, Young, Rochats, Kringelbach, & Stein, 2012).

Need for Additional Research on the Link between Maternal Depression and Infant Growth. Currently, the evidence regarding the link between maternal depression and infant physical growth is conflicting. Studies from South Asia consistently reported that maternal depression was associated with impaired infant physical growth. For example, maternal depression was associated with stunting in India (Harpham, Hutly, Silva, & Abramsky 2005; Patel et al., 2004), Pakistan (Rahman et al., 2004), Vietnam (WHO, 2007)

and Bangladesh (Black et al., 2009). However, studies in Africa reported mixed findings. For example, maternal depression in Malawi, Nigeria and Zambia was found to be significantly associated with poor infant growth, low height- for- age (Adewuya et al.. 2008; Ndokera & MacArthur, 2010; Patel et al., 2003; Stewart et al., 2008), but studies conducted in South Africa and Ethiopia reported contradictory findings. One study conducted in children 3-23 months age in Gilgel Ghibe areas of south-central Ethiopia found that maternal depression was associated with poor overall development (Hadley, Tegegn, Tessema, Asefa, & Galea, 2008) and lower weight-for-age Z-scores (Hadley, Tessema, & Muluneh, 2012). In contrast, four other studies conducted in Ethiopia found no association between maternal depression and infant physical development. Three of these were longitudinal studies conducted in Butajira, Southern Ethiopia, and found that maternal depression was not associated with infant weight and length at age 12 months (Servili et al., 2010), not associated with birth weight (Hanlon et al., 2010), and not associated with infant underweight or stunting at either 6 or 12 months of age (Medhin et al., 2010). Similarly, a cross-national study conducted in a sample drawn from three other countries as well as 20 different sites in Ethiopia by (Harpham, Hutly, Silva & Abramsky, 2005) did not find associations between maternal depression and weight and length of 6-18-month-old Ethiopian infants. Nevertheless these researchers reported that Ethiopia, with the prevalence rate of 33%, had one of the highest rates of maternal depression among the four countries (India, Ethiopia, Vietnam, and Peru) that participated in the study. Similar findings were reported from South Africa. In South Africa, Cooper and colleagues did not find an association between maternal depression and infant weight or length both at age 2 months and 18 months of age (Tomlinson, Cooper, Swartz, & Molteno, 2005). Some studies suggested mechanisms

through which maternal depression negatively affects infant's growth. For example, Hanlon and colleagues found that depressed mothers were less likely to initiate breastfeeding in their newborns (Hanlon et al., 2010) and other studies found depressed mothers to be more likely than non-depressed mothers to stop breast-feeding before their infants were 4-6 months old (Dennis & McQueen, 2007; Hatton et al., 2005; Field, 2010). Surprisingly, the highest rate of infant stunting (43.2%) and underweight (49.2%) in Ethiopia was found in a food surplus zone, West Gojam, northern Ethiopia (DHS, 2005; Teshome, Kogi-Makau, Getahun, & Taye, 2009) and this suggests that some maternal and family variables might be more important determinants of infant growth and development than the availability of food. Another recent study conducted in a sample of children under age 5 years (n=1006) in Gilgel Ghibe, south central Ethiopia, found that maternal depression, household food insecurity and SES independently predicted child underweight (Hadley, Tessema, & Muluneh, 2012). These authors further noted that the link between food insecurity and infant weight was partially mediated (the variance was reduced) when maternal depression was entered into the model. Gibson and associates (Gibson et al., 2008), who studied a convenience sample of 6-23-month- old children (n=97) in Sidama, southern Ethiopia, found high rates of stunting (25% and 52% in two age categories, 6-8 months and 12-23 months, respectively). This study suggested that maternal behaviors might have contributed to infants' poor growth because they found that mothers did not exclusively breastfed their younger infants and were not responsive to the needs of their infants. Similarly, Wachs (2008) suggested three ways through which maternal depression would negatively influence infants' growth in developing countries. Depressed mothers (1) may not feed their infants adequately, or terminate breast feeding earlier than non-depressed mothers, (2) may not respond appropriately to the needs

of their infants, and (3) may not actively be involved in using all possible sources of food to fulfill the needs of their family during food crises.

Unexamined moderator variables may explain inconsistent findings. When relations between predictors and outcomes diverge across studies, the reason for the divergence is often a moderator that differs among the studies. Important moderators may include maternal biological or social risk factors that would exacerbate or attenuate the relation of maternal depression to infant growth and cognition. The importance of maternal breastfeeding for infant growth and development in the developing world suggests that low maternal BMI (Wachs, 2008, 2009) would exacerbate the link between depression and infant growth. Social support (Rahman et al., 2004) is a widely recognized buffer of the effects of depression on children. Finally, economic stress (Bradley & Corwyn, 2002) and infant gender (Sharp et al., 1995; Baker-Henningham, Powell, Walker, & Grantham-McGregor, 2005) have also been found to exacerbate the effects of maternal depression on child developmental outcomes.

In summary, the studies reviewed above emphasize the need for additional research on the link between maternal depression and infant physical growth. First, the findings for the link between maternal depression and infant growth in Ethiopia differ from the findings for other countries and thus require replication. The traditional culture of Ethiopia is one of strong religion and social support (Hanlon, Whitley, Wondimagegn, Alem, & Prince, 2009) and this may account for the cross-national differences in findings. However, replication is crucial. Second, the increasing poverty in the country erodes the capacity of parents, friends, and other community members to provide support to mothers which may increase maternal depression over time (Hanlon et al., 2009), and this suggests further investigation to update

knowledge of relations of maternal depression to growth and development of Ethiopian infants.

Relations of maternal psychological health, mother-infant interaction and demographic factors to infant cognitive development (visual recognition memory)

Terminology. Infant cognitive development is frequently measured by novelty preference, also known as visual dishabituation or visual recognition memory. Memory construction, as measured by novelty preference, is an adaptive process that takes place in all human infants starting at birth and enhances infants' abilities to gather and construct knowledge about their environment which is crucially important for their survival (Shinskey & Munakata, 2010). Many empirical studies have indicated that when a familiar visual stimulus (stimulus to which infants have been habituated) and a novel visual stimulus are simultaneously presented, the majority of infants fixate for a longer time on a novel stimulus than a familiar one (novelty preference), demonstrating the evidence of recognition memory of the familiar stimulus, that is, they respond to the novel stimulus as if they identify it as different from what they have already seen (Shinskey & Munakata, 2010). This novelty preference procedure is also known as a Visual Paired Comparison (VPC) procedure (presenting certain stimulus repeatedly until the infant habituates, or turns attention away from it, and then, presenting a novel object simultaneously with the familiar previously presented object). In this procedure, the length of time infants look at the target stimulus (object) during the familiarization phase and the length of time they look at the novel stimulus during the test phase are indicators of cognitive processing in infancy (Fagan, 1990; Reynolds, Courage, & Richards, 2010; Rose, Feldman, & Jankowski, 2004, 2007). Infants who are shorter lookers, those that take a smaller time to shift their attention from the target

stimulus during the familiarization phase, process information faster than the longer lookers; and during the test phase, looking longer at the novel stimulus indicates more recognition memory capacity (Kavesk, 2004; Rose, Feldman, & Jankowski, 2004). Infants can form memories for visual objects, and when they grow, they encode and retain visual information faster (Fagan, 1990). The evidence from 72 infants of age 4.5 months indicated that infants exhibited selective attention to the familiar stimulus prior to preferring a novel stimulus (Roder, Bushnell, & Sasseville, 2000). The preference for a novel stimulus takes place by matching the novel visual stimulus with the familiar stimulus in the memory. When the visual stimulus matches with the image in the memory, then attention shifts to novel stimulus. Thus, infants focus on the novel until it is well represented in memory (Roder, Bushnell, & Sasseville, 2000).

Maternal psychological health includes maternal depression (defined and discussed above) as well as maternal stress. Maternal stress is defined as physical, mental, or emotional strain or feelings experienced when mothers perceive that the economic and social demand is beyond their resources (Hammen, 2005). Maternal stress in a disadvantaged environment is largely the result of poverty or economic stressors (shortage of money, lack of food for family needs, etc). Evidence indicates that mothers experience stress during the first year after their delivery (Goldstein, Diener, & Mangelsdorf, 1996) which may compromise their interactions with infants, and in turn contributes to poor infant growth and development. Maternal stress during the first year after delivery is associated with poor mother-infant interaction or less maternal sensitivity to infant signals (Pianta & Egeland, 1990). Although there has been no study assessing relations of maternal stress to infant anthropometry, a significant body of literature documented that maternal depression was associated with high

cortisol levels and attention deficit in their infants (Essex, Klein, Cho, & Kalin, 2002; Huizink, Robles de Medina, Mulder, Visser, & Buitelaar, 2002; Kofman, 2002). Usually psychological health problems co-occur, and evidence showed that many depressed mothers had experience of chronic stress, stress that occurred for more than a year (Hammen, 2005). For the current study, maternal stress was measured with assessment of maternal experiences of generally stressful life events and food insecurity.

The concept of mother-infant interaction, including maternal sensitivity/ responsiveness as a key indicator of the quality of mother-infant interaction that affects infant development emerged as part of attachment theory in the 1970s (Ainsworth et al., 1978). Ainsworth et al (1978) defined maternal sensitivity as the mother's ability to read and interpret the infant's needs and interests and respond appropriately. Maternal sensitivity includes various maternal care-giving qualities such as affect, timing, flexibility, acceptance, conflict negotiation, and maternal ability to read infants cues and appropriate responsiveness (van Doesum et al., 2007). Some researchers used the two terms, maternal sensitivity and responsiveness, interchangeably (Blank et al., 1995; Karl 1995; De Wolff & van IJzendoorn 1997; Lecuyer-Maus, 2000; Drake et al., 2007), while others used maternal sensitivity as the competency of mother in child rearing tasks (Pianta, Sroufe & Egeland ;1989; Zahr & Cole, 1991; Pauli-Pott, Mertesacker & Beckmann,2004). Many subsequent empirical studies have indicated that high maternal sensitivity/responsiveness is a foundation for infant's psychological growth and development (Kivijarvi et al., 2001) and fosters secure mother-infant attachment that influences infants' physical, cognitive, and emotional development (van IJzendoorn et al., 2007; Meins et al., 2001; Drake et al., 2007). For the current study, mother-infant interaction included four maternal behaviors: maternal

sensitivity/responsiveness, maternal behavioral attention focus, maternal positive affect, and maternal intrusiveness which were derived from 5 minutes of mother-infant interaction videotaped during culturally appropriate caregiving and play episodes. Maternal demographic factors are discussed in the paragraphs below as part of the conceptual framework.

Conceptual framework. A significant body of theoretical work can explain how poor maternal psychological health (depression and stress), family factors, including low household income, low maternal and paternal education, and poor mother-infant interaction can impede infants' cognitive development. Ecological systems theory (Bronfenbrenner & Morris, 2006) explains that mothers and family as the first level of a system -- the immediate environment or the so-called microsystem -- influence infant development. According to this theory, any problem in the family including poor maternal psychological health, economic and life stress can negatively affect infant development.

Moreover, Wachs (2004, 2008, 2009) proposed the interaction effect of both bio-ecological environment that involves poverty (including poor nutrition, poor sanitation, and parasitic infections) and psychosocial microsystem (inappropriate maternal child care and family factors) contribute to reduced levels of infant involvement with the environment, and thereby result in impaired development of the central nervous system and poor cognitive outcomes. In addition, in the family stress theory, maternal depression, stress, and low social support were postulated as some of the paths through which poverty influences parenting behaviors in the United States (Brooks-Gunn, Klebanov, & Liaw, 1995). Compared to non-poor families, poor families experienced more risk factors that adversely affected parenting and, in turn, contributed to poor infant development. In addition, the transactional theory

(Sameroff & Mackenzie, 2003) stressed that mother-infant interaction, which is bidirectional in nature influences infant's cognitive and behavior development. Most recently, Quitmann and associates (Quitmann, Kriston, Romer & Ramsauer, 2011) explain the mechanisms by which maternal depression influences mother-infant interaction as the following: Maternal depression alters parenting behaviors by (1) reducing maternal insightfulness and emotional availability, (2) limiting the mother's ability to perceive infant signals and respond promptly and appropriately, and (3) reducing maternal eye-contact, imitation and speaking, and interactive play.

Need for Additional Research on the Links among Maternal Psychological Health, Mother-Infant Interaction, Demographic Factors and Infant Cognitive Development. A significant body of empirical evidence shows that maternal depression and poor socio-economic conditions have adverse effects on mother-infant interaction and thereby contribute to poor infant cognitive development. For example, in South Africa, compared to non-depressed mothers, depressed mothers were found to be less sensitive to infant signals during interaction, and correspondingly their infants were observed to be less engaged during interaction with their mothers (Cooper & Murray, 1998; Cooper et al 2002). Moreover, a large body of research investigated associations of maternal depression, family economic status, and social support with mother-infant interaction and infant cognitive development. For example, children from low socio-economic status were expected to perform poorly on developmental measures because of lack of material and social resources (Brooks-Gunn & Duncan 1997; Dooley & Stewart, 2007). In contrast, the most recent study by Violato and associates presented evidence that after controlling for some covariates, such as maternal depression, stimulating home environment, and length of breast feeding, family

socio-economic status had little or no effect on child cognitive development, as measured by the Communicative Development Inventory (CDI, Violato, Petrou, Gray, & Redshaw, 2011). These researchers further indicated that maternal depression, stimulating home environment, parenting practices, and length of breast feeding are mediators through which family economic resources are translated into child development. Likewise, maternal depression was found to be associated with poor mother-infant interaction (Field, 2010; Kemppinen, Kumpulainen, Moilanen and Ebeling 2006; Kersten-Alverez et al., 2010; Murray & Cooper, 1997; Steadman et al. 2007). In contrast, other researchers found no association between maternal depression and mother- infant interaction. In Brazil, Fonseca, Silva and Otta (2010) and, in Germany, Sidor, Kunz, Schweyer, Eickhorst and Cierpka (2011) did not find any association between maternal depression and maternal sensitivity, responsiveness, or controlling behaviors. A few studies conducted in low–income countries showed positive association between maternal depression and poor mother-infant interaction. For example, in Bangladesh, depressed mothers were less responsive to their infants (Black, et al., 2009) and in South Africa depressed mothers were found to be both less sensitive and more intrusive during interaction with their infants (Cooper et al., 1999). Studies further indicated social support played a protective role against adverse effects of maternal depression on mother-infant interaction and infant outcomes. For instance, social support was associated with reduced maternal depression (e.g. Silva, Huttly, harpham and Kenward, 2007; Surkan, Peterson, Hughes, & Gottlieb, 2006) and social support is helpful for mothers because it provides mothers with child rearing information and models of how to raise babies, and also reduces caretaking burden by providing direct caretaking support to mothers (Burchinal, Folmer, & Bryant, 1996).

Maternal behaviors, responsiveness, and sensitivity to infant cues were associated significantly and positively with cognitive outcomes in infants and toddlers (Murray, 1996). More evidence from a sample of full term neonates (n= 20) of depressed and non-depressed mothers showed that neonates of depressed mothers required more trials and longer time to habituate to their mothers' face than did the neonates of non-depressed mothers (Herndez-Reif, Field, Diego & Large, 2002). The same study further identified that the infants of depressed mothers did not demonstrate novelty preference but the infants of non-depressed mothers did. The most recent evidence from a sample of five-month-old infants (n=36) of depressed and non-depressed mothers confirmed that infants of depressed mothers failed to discriminate between the familiar and novel stimulus, whereas the infants of non-depressed mothers successfully discriminated the familiar stimulus from the novel (Bornstein, Mash, Arterberry & Manian, 2012). In their previous study, the authors reported that the five-month-old infants of depressed mothers failed to discriminate between neutral and smiling facial expressions of a face, but the infants of non-depressed mothers successfully discriminated between neutral and smiling facial expressions of a face (Bornstein, Arterberry, Mash & Manian, 2011). Furthermore, a significant body of literature reported that visual attention and recognition memory, measured with VPC during infancy, predicted cognitive outcomes in childhood and later in life (Domsch et al., 2009; Kavsek, 2004). Many studies, however, suggested visual habituation (infant's information processing capacity) may not directly represent intelligence, rather it represents a foundation for infant's learning and future mental development (Bornstein et al., 2006; Colombo et al., 2004) and the procedure needs validation in different cultures (Colombo & Mitchell, 2009).

Regardless of the extensive literature concerned with associations of maternal resources (depressive status, economic, and life stress) with infant cognitive development, the inconsistency in previous findings and the few studies in Ethiopia emphasize the need for the current study. Particularly in Ethiopia, I found only three studies that assessed infant cognitive development and its correlates. One study assessed the association of maternal anthropometry and infant novelty preference (visual recognition memory) in a of sample 6-8 month-old infants (n=100) and their mothers recruited from Sidama, south Ethiopia, and found no relation between the two variables (Sykova, 2006). The other study conducted by Kennedy et al (2008), using the same source of data used by the preceding researcher but excluding those infants with fewer than three complete trials which reduced the sample to 69 infants, found that underweight infants had longer looks during the familiarization phase than the normal weight group and stunted infants had lower shift rate both during the familiarization and the test phases, indicating significant negative association between information processing (look duration) or recognition memory (shift rate) and poor physical growth. Most recently, Aubuchon-Endsley and colleagues who used a longitudinal design with a sample of infants (n=108) selected from the same area, Sidama, Ethiopia, reported that infants' attention performance in a multiple object free play task worsened from 6 to 9 months of age. Infant anthropometry including weight and length predicted attention at age 9 months, indicating that poor growth negatively influences infant attention (Aubuchon-Endsley, Schrader, Grant, Berhanu, Thomas, et al., 2011).

In sum, the need for the current study is supported by the following: (1) inconsistency of literature regarding the association between maternal depression, stress, and socio-demographic variables with mother-infant interaction and infant physical and cognitive

developmental outcomes; (2) only a few studies are available that assessed the association of maternal depression and stress and mother-infant interaction with infant outcomes (weight, length and recognition memory) in Africa in general and in Ethiopia in particular (e.g., Cooper et al., 1999). Given that, this study will simultaneously examine the associations of the aforementioned variables with mother-infant interaction and infant's physical and cognitive outcomes. To date, to the researcher's knowledge, there is no such study in Ethiopia that assessed the associations of maternal depression and stress, social support, socio-demographic variables (maternal and paternal education, household material asset and subjective/perceived social status) with mother-infant interaction and infant physical growth (weight and length) and cognition (recognition memory).

The main purpose of the present study is to assess relations of maternal depression, stress, social support and socio-demographic factors (maternal and paternal education, family economic resources and subjective/perceived social status, family size, etc.) with mother-infant interaction and infant physical growth (weight and length) and cognition (recognition memory) in Wolayita rural villages, Southern Ethiopia. There are two reasons for locating the study in Soddo Zuria, Wolayita. First, Wolayita has been identified as having high food insecurity -- with 74.2% of food insecure households (Eneyehu & Bekele, 2012) and currently has been categorized as one of the zones stressed by food insecurity in southern Ethiopia (Famine Early Warning Systems Network-Ethiopia [FEWS NET Ethiopia], 2011), -- and severe child undernutrition -- high wasting, stunting and underweight (Lawrence, Yimer, & O'Dea, 1994) -- conditions which demand research to identify protective maternal and family factors associated with resilience to this problem. Second, the researcher is fluent

in the Wolayita language which is a critical factor in coding videotapes and assuring the quality of data collection.

1.2. Research objectives

1.2.1. To assess relations of maternal characteristics (depression, stress, perceived social support, and behaviors) and socio-demographic variables (household material wealth, mother's and father's education, family size, family cattle ownership and housing quality with infant outcomes (weight and length and recognition memory).

1.2.2. To identify the percentage of variance explained by maternal depression and stress (life events stress and food insecurity stress) over and above demographic variables in each model predicting infant outcomes (weight, length and recognition memory).

1.2.3. To assess whether maternal low BMI, social support and stress, household asset/SES, food insecurity or infant gender moderate the link between maternal depression and infant outcomes (weight, length, and recognition memory).

1.2.4. To assess whether maternal depression and stress were related to maternal behaviors (warmth and sensitivity, behavioral attention focus, intrusiveness, and positive affect) during mother-infant interaction.

1.2.5. To assess whether maternal behaviors in interactions with their infants or infant behaviors in those interactions are related to infant recognition memory.

1.3. Research questions and hypotheses

1.3.1. Is maternal depression significantly and negatively associated with each of the infant outcomes (weight and length and recognition memory) or is the relation between depression

and infant outcomes moderated by other risk factors such that the relation is significant only in the presence of heightened risk?

Hypothesis 1: Maternal depression will be significantly and negatively associated with each of the infant outcomes.

Hypothesis 2: The relation between maternal depression and infant outcomes is moderated by other risk factors such that the association will only be significant when other risk factors are high: low maternal BMI, infant gender, low maternal social support, low maternal economic assets (SES), and high food insecurity.

1.3.2. Is maternal stress (both food insecurity stress and stressful life events) significantly and negatively associated with infant outcomes (weight and length and recognition memory)?

Hypothesis 3: Food insecurity stress and stressful life events will be significantly and negatively associated with infant outcomes.

1.3.3. Are maternal behaviors toward infants (responsive, intrusive, positive affect, attention focus) related to maternal depressive symptoms?

Hypothesis 4: Maternal depressive symptoms are related to maternal behaviors toward infants during play or caregiving.

Hypothesis 5: The relation between maternal depressive symptoms and maternal behaviors is moderated by other risk factors: low maternal BMI, infant gender, low maternal social support, low maternal economic assets (SES), and high food insecurity.

1.3.4. Do stunted, wasted, or underweight infants, compared to infants of normal weight and length, demonstrate poorer recognition memory (novelty preference)?

Hypothesis 6: Compared to infants with normal growth, stunted, wasted, and underweight infants will have significantly lower scores on measures of recognition memory.

Hypothesis 7: Stunting, wasting, and underweight classification and maternal depression classification interact to impact measures of recognition memory. (Stunting, wasting and underweight are defined using WHO Z-scores that are recognized criteria for moderate undernutrition: length-for-age (LAZ) < -2.0, weight-for-length (WLZ) < -2.0, and weight-for-age (WAZ) < -2.0, respectively. Maternal depression classification is discussed in detail in chapter III)

1.3.5. Are maternal and infant behaviors during mother-infant interaction related to measures of infant recognition memory?

Hypothesis 8: Positive maternal and infant behaviors during interaction will be positively correlated with novelty preference and negatively correlated with longest look and the reverse will be true for negative maternal and infant behaviors *and maternal depression*.

CHAPTER II

LITERATURE REVIEW

This section has two main purposes. The first is to assess and discuss the findings of studies concerned with associations of maternal depression and stress, social support, and socio-demographic variables to mother-infant interaction and infant anthropometric and cognitive outcomes. The second is to pinpoint gaps in the research that require further investigation in order to understand maternal and family factors that contribute to optimum infant development.

2.1.1. Prevalence of maternal depression and its predictors. Maternal depression, because of its adverse impact on infant growth, is one the major public problems in high-income countries of the world and its prevalence ranges between 7% and 13% (Parsons et al., 2012). However, less attention has been paid to maternal depression in low-income and middle-income countries. For example, only about 10% of the total published studies concerned with maternal depression were conducted in low–income and-middle income countries (WHO-UNFPA, 2008). Moreover, the extant literature indicated that there has been higher prevalence of maternal depression, about 15-57 %, in these countries than in high-income countries (Parsons et al., 2011). The prevalence rate, however, differs from country to country. For example, in Latin America the prevalence rate of maternal

depression ranges 35-50% (Wachs, 2008). Rates differ across South East Asian countries; in India 11.5% (Prost et al., 2012), in Vietnam 33% (Parson et al., 2011), in Pakistan 28 - 63.3 % (Rahman et al., 2003; Klainin & Arthur, 2009) of mothers were suffering from depression. In Africa there are also differences; for example, in South Africa 34.7% (Cooper et al., 1999; 2009), in Zimbabwe 33% (Chibanda et al., 2010; Parsons et al., 2012), in Uganda 43% (Kakyo, Muliira, Mbalinda, Kizza, & Muliira, 2011), in Malawi 29.9% (Stewart et al., 2008), and in Ethiopia 37% (Hadley et al., 2008) of mothers are reported to be suffering from depression.

The comparison of maternal depression status reported by different studies in Africa is also confusing because some of these studies either used different measuring instruments or the same instrument with different cut-points. For example, Kakiyo et al. (2011) with Ugandan mothers used a score above 9 on the Edinburg Postnatal Depression Scale (EPDS) as the cutoff score for the depressed group, whereas Chiband et al. (2010) with Zimbabwean mothers used EPDS score above 10, Stewart et al. (2008) with Malawian mothers used Self-Reporting Questionnaire (SRQ20) ≥ 8, and Hadley et al. (2008) with Ethiopian mothers used Hopkins Symptom Checklist (HSCL) ≥ 1.75 to categorize mothers into depressed or nondepressed groups.

In addition to assessing the prevalence rate of maternal depression, a significant body of research examined the risk and protective factors of maternal depression. For example, high maternal age, low household assets, and poor health were some of the factors that put mothers at risk of depression in India (Parsons et al., 2011). In addition, the study of mothers attending maternity clinics (n=210) in Zimbabwe revealed maternal experience of stressful life events as a major predictor of maternal depression (Chibanda

et al. 2010), and previously a meta-analysis of 1990s studies in the United States indicated that life stress was a moderate predictor of maternal depression with an effect size of .19-.22 (Beck, 2001). In Malawi, a study of mothers attending rural child health clinics (n=519) reported that maternal depression was significantly predicted by low household wealth, marital conflict, and infant illness/diarrhea (Stewart et al., 2010). In rural Uganda, a study of mothers-infant dyads (n=202) using maternity service clinics in public hospitals showed that marital conflict and parity were positively associated but husband's support during the postpartum period was negatively associated with maternal depression (Kakyo et al., 2011). Moreover, the relation of social support to maternal depression was reported to be higher (effect size of .36-.41) than life stress in the meta-analysis of 1990s research in the United States (Beck, 2001). A recent review of published literature on maternal depression in Africa indicated that maternal depression is consistently associated with poor social relations in the first year after delivery of an infant (Sawyer, Ayers, & Smith, 2010). Prost and associates suggested that in some traditional cultures, social customs that encourage social support among family members played a protective role against maternal depression (Prost et al., 2012). Cultures that exhibit less preference for male gender at birth and have gender equality in division of labor could have lower rates of maternal depression (Chandran, Tharyan, Muliyil & Abraham, 2002). Furthermore, a study that involved different races and ethnic groups, with three categories (whites, blacks, and others) in USA indicated that younger maternal age (18-24 years), poverty, and lack of social support are risk factors contributing to higher prevalence of maternal depression (Wang, Wu, Anderson, & Florence, 2011).

The few studies of maternal depression that have been conducted in rural Ethiopia also showed high prevalence of maternal depression and suggested that poverty that interferes with some traditional customs functions as one of the major risk factors of maternal depression. For example, a series of studies conducted in Butajira, southern Ethiopia, predicted an increasing trend of maternal depression in the future because of the declining household economic status and increasing rate of poverty in the region (Hanlon et al., 2009). The increasing level of poverty has reduced the family's capacity to adhere to social rituals of celebrating the birth of new babies by killing animals and feeding the mothers in a special way (e.g., with meat, milk, and other animal products) during the postpartum period. The authors further noted that traditional cultural preference for male gender and isolation of mothers from social activities during late pregnancy and postnatal periods are risk factors that have contributed to the development of depression (Hanlon et al., 2009; Hanlon et al., 2010). Another study that assessed the relations of maternal depression to food insecurity and stressful life events in south-western Ethiopia, that is, the Gilgel- Ghibe areas, provided further evidence of high prevalence of maternal depression in rural Ethiopia (Hadley et al., 2008). According to the report of this study, after controlling for confounding variables, maternal depression was independently and significantly predicted by food insecurity and mother's experience of stressful life events (Hadley et al., 2008). This finding confirmed the previous study of Hadley and his colleagues which reported a positive association between maternal depression and food insecurity in a sample of predominantly rural mothers (n=440) in Tanzania (Hadley & Patil, 2006).

2.1.2. Relations of maternal depression and infant anthropometry. Most studies that assessed the impact of maternal depression on infant developmental outcomes were conducted in high-income countries and relatively few studies have been done in low-income and middle-income countries where 90% of the world's children are living (Wachs, 2009). Moreover, the bulk of the existing research focused on children's psychological outcomes (emotional, cognitive, and attachment) ignoring physical growth, probably because poor physical growth is not the problem of high income countries (Tomlinson, Cooper, Stein, Swartz, & Molteno, 2006).

A recent meta-analysis of 17 published articles with 13,923 mother-infant dyads in 11 low-income and middle-income countries of the world, including 4 studies from Africa, six from South America and the Caribbean, 6 from southern Asia, and 1 from south-east Asia, found that children whose mothers were depressed are at higher risk of underweight and stunting (Surkan, Kennedy, Hurley, & Black, 2011). The authors optimistically estimated that if maternal depression is early identified and treated, child stunting and underweight will be reduced by about 23-29% from the current amount. However, these authors found no clear mechanism that associated maternal depression with infant growth and recommended that future research particularly focus on mechanisms linking maternal depression to poor infant developmental outcomes. The current study focuses on maternal behaviors as potential mechanisms.

Numerous studies conducted in south Asian countries have shown that maternal depression is a major detrimental factor for infant growth and development. For example, a longitudinal study that assessed maternal depression in a sample of Pakistani mothers (n=360) from pregnancy until 12 months of infant age showed that maternal

depression both during pregnancy and after birth, at 2, 6 and 12 months of infant age, was significantly associated with poor infant growth (weight-for-length, weight-for-age, and length-for-age), even after the influence of socio-economic status and infant birth weight were controlled (Rahman, Iqbal, Bunn, Lovel, & Harrington, 2004). These authors concluded that relative risk of being underweight and stunted is greater in infants of depressed mothers than in infants of non-depressed mothers, and based on the data, the researchers estimated that the reduction in the prevalence of maternal depression could reduce infant growth retardation by about 30%. Furthermore, in a later study, Rahman and associates estimated that treating maternal depression will improve infant growth and reduce infant stunting by 20 percent in Pakistan (Prince et al., 2007).

In Latin America, for example, a Jamaican study reported that underweight children, when compared to the normal weight children, had mothers with more depressive symptoms (Baker-Henningham, Powell, Walker, & Grantham-McGregor, 2003). A similar study in Brazil also found a significant positive association between maternal depression and underweight in children (de Miranda, Turecki, Mari et al., 1996). A later study in Brazil that was conducted in a sample of 595 mothers with their 6- to 24- month-old children reported significant positive association between maternal depression and short stature even when the effects of other risk factors (birth weight, SES, maternal education) were controlled (Surkan 2007). In contrast, Harpham, Hutly, De Silva, and Abramsky (2005) did not find any association between maternal depression and children's weight and length/height in Peru.

In Africa, the association between maternal depression and infant weight and length is unclear. For example, in Nigeria, a longitudinal study of 242 mothers (120

depressed and 122 non-depressed) and their infants, using a non-patient version of the Structured Clinical Interview for DSM-III-R (SCID-NP), found significantly poorer growth (thinner and shorter) in infants of depressed mothers than in infants of non-depressed mothers at the age of 3 months and 6 months (Adewuya, Ola, Aloba, Mapayi, & Okeniyi, 2008). A similar study in Zambia used a Self-Reporting Questionnaire-20 (SRQ20) with a cut-off ≥ 8 for mothers with high risk of depression. In this group of mothers (n=286) attending maternity health clinics with their 2- 12- month-old infants the researchers found a significant association between maternal depression and infant weight and length after controlling for maternal age and weight and infant gender, i.e., infants of depressed mothers were slightly lighter and shorter than the infants of nondepressed mothers (Ndokera & MacArthur, 2010). In Malawi, a study of mother-infant dyads (n=519) recruited from rural child health clinics found a significant negative association between maternal depression and infants' length-for age Z scores, but this study did not find an association between maternal depression and infant weight in the first year (median age 9.9 months) (Stewart et al., 2008). In contrast, Cooper and associates who recruited mother-infant dyads (n=147) from peri-urban areas of South Africa did not find an association between maternal depression and infant weight and length at 2 and 18 months of age after controlling for birth weight (Tomlinson, Cooper, Stein, Swartz & Molteno, 2006). However, a recent study that assessed maternal depression at 6 months after delivery (n=891) in Johannesburg in the same country (South Africa) found a significant positive association between maternal depression and infant stunting at age 2 (Avan, Richter, Ramchandani, Norris, & Stein, 2010). Some researchers speculated that cultural factors, including male gender preference, breast-

feeding patterns, maternal nutrition, and other social factors are reasons for the differential association of maternal depression with infant physical growth (Tomlinson, Cooper, Stein, Swartz & Molteno, 2006). The speculation by this research team suggests the importance of examining maternal nutrition (low body mass index [BMI]) and infant gender as well as social support and other social factors (such as family economic assets) as moderators of the relation between maternal depression and infant physical growth. Furthermore, Wachs (2008) suggested maternal behaviors (mother-infant interaction) as the major mechanism through which maternal depression is linked to infants' poor physical growth in low- and middle-income countries. As noted in chapter 1, Wachs offers several differences in maternal behavior that could be linked to maternal depression, two of which have to do with mothers' feeding behaviors of their infants (terminating exclusive breast- feeding earlier than 4-6 months of infant age and lack of capacity to use all available sources of food during food crises). The current study focuses on the broader category of maternal behaviors, including maternal responsiveness, intrusiveness, and positive affect as potential maternal mechanisms that may link maternal depression with infant growth and development.

Studies that examined maternal stress and depression as separate constructs reported that they are associated with different outcomes in infants. For instance, Tegethoff et al. (2010) found that maternal life stress during pregnancy was associated with greater infant weight, length, and head circumference, but maternal depression was associated with shorter body length at birth. Similarly, other earlier studies indicated that maternal exposure to stressful life events during pregnancy was associated with lower birth weight (Cooper et al., 1996; Khashan et al., 2008) and shorter body length at birth

(Lederman et al., 2004). Moreover, Brand and Brennan (2009) after reviewing longitudinal studies concluded that maternal depression and stress were associated with different negative outcomes in infants, and when the two variables were compared, maternal stress was more strongly and consistently associated with negative outcomes in infants than maternal depression.

In Ethiopia, very few previous studies have investigated maternal depression and its influence on infant and child development, and these studies have reported contradictory findings. For example, Harpham and colleagues, who used a representative sample from different parts of Ethiopia, found no association between maternal depression and infant weight and height (Harpham, Hutly, De Silva, & Abramsky, 2005). Recently, a longitudinal study conducted from pregnancy until age 12 months in Butajira, South Ethiopia, reported that maternal depression measured with the Self Reporting Questionnaire-20 (SRQ20) with a cut-off ≥ 6 was associated with none of the infant development measures assessed with the Bayley Scales of Infant Development (BSID, 3rd Edition: Bayley, 2006), including motor, cognitive, and language development at age 12 months (Servili et al., 2010). Another study by Medhin et al. (2010), who assessed maternal depression with SRQ20 at pregnancy and 2 months after birth in Butajira did not find any association between maternal depression and infant weight or length at age 6 months and 12 month. In contrast, another study conducted in Gilgel Ghibe, south-western Ethiopia, reported that maternal depression was strongly associated with general development scores, measured with Denver II test (Frankenburg et al., 1992), including gross-motor, fine motor, and social development but not cognitive/language outcomes (Hadley, Tegegn, Tessema, Asefa, & Galea, 2008).

More recently, Hadley and collegues, who assessed relations of maternal depression and food insecurity to infant growth and development in the same site (Gigel Ghibe, south west Ethiopia) with Hopkin's Symptom Checklist (HSCL) found that maternal depression was strongly associated with household food insecurity, and both of them were independently associated with low infant weight-for- age (Hadley, Tessema, & Muluneh, 2012). Thus, currently findings concerned with relations of maternal depression to infant growth and development in Ethiopia are mixed. This is why the current study has focused on assessing associations of maternal psychological resources (depression and stress status and social support) with maternal behaviors and infant developmental outcomes (weight, length and recognition memory) and moderators of these associations.

In general, evidence from resource-poor countries showed that infant poor growth (stunting, wasting, and underweight) may not always be caused by lack of food or lack of money to purchase food. For example, in Haiti high food production was correlated with high infant malnutrition and poor growth (Mulder-Sibanda, Sibanda-Mulder, Alois, & Verna, 2002), and in Ethiopia surplus food production was associated with higher rate of stunting and underweight in West Gojam zone, northern Ethiopia (DHS, 2005; Teshome, Kogi-Maqau, Getahun & Taye, 2009). Similarly, in Ghana, maternal education was found to be more important for infant healthy growth than the availability of food and material wealth (Armar, Klemesu, Ruel, Maxwell, Levin, & Morris, 2000). This evidence suggests that more research is needed to identify maternal and family factors contributing to infant physical growth.

2.1.3. Relations among maternal depression, mother-infant interaction and infant visual recognition memory (cognition)

Empirical studies indicated that infants of depressed mothers have different experiences from infants of nondepressed mothers. For example, Bornstein, Arterberry, Mash, and Manian (2011) found that infants of depressed mothers did not discriminate neutral facial expression from smiling facial expression but infants of non-depressed mothers correctly differentiated the two facial expressions. In their most recent study, these authors further noted that infants of depressed mothers at age of 5 months failed to discriminate between the familiar and the novel views of an object, but the infants of non-depressed mothers successfully discriminated the novel from the familiar (Bornstein, Mash, Arterberry & Manian, 2012). Many other studies noted that infants of depressed mothers, compared to infants of non-depressed mothers, had more attention deficits (Field et al., 2004; Field et al., 2009; Field 2011) and had weaker information processing ability (Field et al, 2004). One study that assessed maternal depression at 2 months after delivery found a significant positive association between maternal depression and poor infant cognitive outcome at age 18 months, measured with the Mental Scale (MDI) of the Bayley Scales of Infant Development 2nd edition (BSID-II: Bayley, 1993) (Conroy et al., 2012).

Mothers enhance their infant's attention focus and exploration by arranging objects and play materials, and by pointing to and demonstrating the characteristics of objects (Lawson, Parrinello, & Ruff, 1992). Conversely depressed mothers because of their either intrusive or withdrawn behaviors may contribute to the delayed attention engagement and poor development of exploration skills and cognitive competences in the

infants by not engaging in these activities (Hart, Aaron, Field & Lundy, 1999). In this study of one-year-old infants, the infants of depressed mothers, compared to infants of non-depressed mothers, demonstrated more diminished exploration ability, less focused attention, more negative affect, and less positive affect (Hart et al., 1999).

Some researchers have speculated about reasons why infants of depressed mothers perform more poorly in attention and recognition measures. Bornstein and associates speculated that both genetic and environmental factors are possible causes for poor discrimination skills and attention deficits in infants of depressed mothers (Bornstein, Mash, Arterberry & Manian, 2012). Among the genetic factors, for example, Field (1992) found that infants of depressed mothers have inherited higher levels of stress hormones (cortisol) which have the power to reduce attention. Many other studies indicated poor mother-infant interaction as a possible factor contributing to poor recognition memory and attention deficit in infants of depressed mothers. For example, maternal depression, characterized by negative affect, sadness, fatigue, loss of interest in daily activities, and intrusive and withdrawal behaviors, may impair maternal caregiving ability and disrupt mother-infant interaction (Manian & Bornstein, 2008; Mcquaid, Bigelow, McLaughlin, & MacLean, 2008; Paulson, Dauber & Lieferman, 2006).

Despite a large body of both theoretical and empirical research investigating the impact of maternal depression on infant developmental outcomes, the particular circumstances in which depression is linked to adverse infant outcomes are still unclear. Currently the knowledge regarding the association of maternal depression with infant cognitive outcomes as a function of varying maternal age, income, education and socio-economic status is not well established. Some studies conducted in a sample of low SES

families reported that maternal depression measured during the first year of infancy had long lasting adverse effects on infant cognitive development, identifying that infants of depressed mothers scored lower in cognitive measures compared to infants of non-depressed mothers (Cogill, Caplan, Alexandra, Robson, & Kumar, 1986). However, this study did not assess multiple risk-factors of depression in the low SES setting. Other studies reported that adverse effects of maternal depression vary with infant or child gender. For example, Sharp and colleagues reported that maternal depression had adverse effects on boys but not on girls (Hay, 1997; Murray, 1992; Sharp et al., 1995; Kurstjens and Wolke, 2001)). Other studies did not find gender difference; both boys and girls of depressed mothers performed lower on cognitive tests than did boys and girls of nondepressed mothers (Cornish et al., 2005; Hay et al., 2001).

Many studies suggest mother-infant interaction as a major mediator of the adverse effect of maternal depression on infant cognitive development (e.g., Milgrom et al., 2004). For example, Cooper et al. (2009) evaluated the effectiveness of their intervention project that aimed to reduce maternal depression and improve mother-infant interaction (improve maternal sensitivity and responsiveness) in a poor peri-urban community in South Africa (participants n= 449). The intervention was carried out by community workers. The community workers trained mothers to be sensitive to infant cues and respond appropriately to the needs of their infants from pregnancy until 6 months after birth. The evaluation of this project showed that quality of mother-infant interaction assessed at 6 and 12 months of infant age in the intervention group was more sensitive and less intrusive than the control group at 6 and 12 months in free play interaction with their infants (Cooper et al., 2009). In addition, the intervention was associated with lower

maternal depressed mood at 6 months. Thus, experimental increases in maternal sensitivity and responsiveness appear to be linked to decreased maternal depressed mood which suggests that sensitivity and responsiveness may be the mechanisms linking maternal depression and infant cognition. Moreover, Wachs (2009) states that maternal behaviors are influenced by both maternal depression and nutrition status, suggesting that infants of depressed and undernourished mothers may be at greater risk of receiving developmentally inappropriate care and stimulation than the infants of depressed but well-nourished mothers. Another study further indicated that infants whose mothers were depressed at 6 months of age and interacted with them in less responsive styles scored lower on an IQ test at age 42 months than the infants whose mothers were not depressed at age 4 months (Milgrom et al., 2004). The researchers tested the mediation model and found that the association of maternal depression and infant IQ scores was mediated by maternal responsiveness, or the association between IQ score and depression was attenuated when maternal responsiveness was entered into the model. Thus, some research found maternal depression is associated with maternal behaviors (Wachs, 2004, 2008, 2009) and others showed that maternal depression was associated with infant cognitive outcomes (Cogill et al., 1986) and others indicated that maternal behaviors mediated the effects of maternal depression on infant cognitive outcomes (Milgrom et al., 2004). Thus, the present study aimed to assess the associations of maternal depression, stress, and behaviors (responsiveness/intrusiveness) to infant outcomes simultaneously, to identify the extent of association among the predictor variables (maternal depression, stress and social support and responsive/intrusive behaviors) and which of them significantly predicts each infant outcome (weight, length or recognition memory) after

controlling for the effect of others. The evidence for maternal behavior as a mediator is not strong and has never been tested to the researcher's knowledge in the developing world so it is not hypothesized but will be explored.

2.1.4. Relation of infant poor physical growth (stunting and underweight) and cognition (recognition memory)

A longitudinal study conducted in 1,674 Peruvian infants and children found that stunting, both at age 6-18 months, and concurrent stunting at 4.5-6 years, was significantly associated with poor cognitive performances (Crookston, Dearden, Alder, Porucznik, Stanford et al., 2011). The authors further noted that maternal older age (mean age = 26. 69, SD= 6.62), higher education, higher household wealth, and fewer siblings were all associated with higher cognitive scores at both age levels.

Poor growth in infancy, which is the indicator of undernutrition, has the potential to negatively influence the development of brain, reduce the development of its structures and the size of the brain, alter the function of the nervous systems, and impair cognitive functioning (Laus, Vels, Costa, & Almeida, 2011). However, this recent literature review indicated that although growth impairment during infancy is associated with poor cognitive ability, there is no clear understanding of whether poor physical growth (as the indicator of nutrition deficiency) or poor maternal stimulation contributed to the adverse effect. In most cases, nutrition deficiency and social and cultural deprivation, including poor maternal stimulation, occur together. This makes separating the effects of each on cognitive functioning very difficult (Laus, Vels, Costa & Almeida, 2011). The

mechanism that links poor physical growth, undernutrition, and poor maternal stimulation with adverse outcomes in infants and children may be explained by the functional isolation hypothesis (Levitsky & Barnes, 1972; Wachs 2004, 2009). According to the functional isolation hypothesis, nutrition deficiency can negatively affect cognitive outcome either directly by influencing brain and central nervous system development during the sensitive periods of infancy or by indirectly resulting in poor interaction with mothers, i.e., malnourished children because of lack of energy may fail to initiate interaction with their mothers and/or may not manipulate the environment around them to stimulate their cognitive development (Wachs 2004, Laus, Vels, Costa & Almeida, 2011). Wachs (2004) suggested that nutritional deficiencies (indicated by poor physical growth) biologically lead to impaired central nervous system development and psychosocially lead to reduced infant involvement with the environment as well as poor mother-infant interactions, with mothers' treating their infants as if they were younger than they are. Evidence from a longitudinal study conducted on 58 adopted children (mean age 17.6 months) showed that although these children have grown up in wealthy families in USA, their cognitive score was poor compared to the standard population; they achieved BSID, MDI score 88.8 at mean age 26.9 months which is lower than the average (100) of the standard population, indicating that early impaired growth (low weight-for-height and low weight-for-age and low height-for-age) is linked to later adverse cognitive performance (Park et al., 2011). Laus, Vels, Costa, and Almeida (2011) suggested that future studies need to focus on identifying the interaction effects of nutrition as measured by infant anthropometry (WAZ and HAZ) and maternal stimulation on infants' and children's cognitive development.

In Ethiopia, only a few studies have investigated the association of poor growth with infant and children's cognitive development. One study that assessed cognitive outcome with Bayley Scales for Infant Development (BSID II/ MDI) in rural Ginchi, Oromiya Region, Ethiopia, showed that stunting (low height-for-age) was associated with poor cognitive performance (Ketema, Abate, & Jabar, 2003). Another two studies conducted in Sidama found significant positive associations between poor infant growth and poor cognitive performance. One of these studies was conducted on 6-8 month-old infants measuring cognitive outcome with Visual Paired Comparison (VPC) and found that infant longest look during familiarization phase, which is the indicator of slow or poor information processing, was predicted by weight-for-age and length-for-age while the duration of mean look during test phase was predicted by head circumference (Kennedy et al., 2008). Another study that used the Kaufman Assessment Battery for Children-II (KABC-II) also reported that stunted and underweight children (age 5 years) scored significantly lower than children with normal linear growth and normal weight respectively (Bogale et al., 2011).

In sum, as indicated in the review above, although a large number of the world's children are living in low- and middle-income countries of the world, most of the existing literature of child development is concerned with infants and children in high income countries. Little has been known about maternal resources (depression and stress status), mother –infant interaction, and family factors, and their association with infants' physical and cognitive outcomes in economically poor countries of the world (Wachs, 2004). Compounding the problem of the scarcity of research in economically poor areas of the world, the existing findings are also conflicting, suggesting that much more research is

required to clarify associations of maternal and family variables with infant developmental outcomes.

CHAPTER III

METHODOLOGY

Overview of Study Design

Two phases of data collection were implemented using a correlational design. During the first phase, data on mothers' demographic information, psychological health, and anthropometry as well as infants' anthropometry were collected. During the second phase, data on mother-infant interaction and infant recognition memory were collected. Sample selection for both phases is discussed below.

3.1. Participants, research site and sampling procedure

Participants in phase 1 were 201 and in phase 2 were 73 mothers and their infants (age 8-17 months) living in rural villages in the Wolayita zone (named for the Wolayita ethnic group inhabiting the area) is located in the Southern Nations, Nationalities, and Peoples Region (SNNPR), Ethiopia. The Wolayita zone with its capital Soddo is situated about 330km south of Addis Ababa, the capital city. The Wolayita ethnic group is the seventh largest ethnic classification in the country (1,707,074 population: CSA, 2007).

A nested convenience sampling design was used to select participants. First, a convenience sample of 201 mothers with their infants (age 8-17 months) were selected from four rural subadministrative units (kebeles) of Soddo-Zuriya (one of the 13 administrative units of Woalyita zone): Quxo-Sorfella, Waja-Qero, Kokate-Marachere.

and Humbo-Larena. These villages were purposefully selected for the following reasons: (1) They are near to Wolayita University where the researcher stored his field materials (computers, projector, stabilizer/voltage regulator, generator, metal supporters and sheets for shelter-making) during weekends, and (2) they are relatively more accessible rural administrative divisions, because their administrative offices and community centers are located across the main roads which made driving easier for the research team.

The participant recruitment was conducted in two phases. In the first phase, which was conducted between October 10 and November 8, 2011, 201 mothers were selected and all of them were interviewed and anthropometric data of the mothers and their infants were collected. The interview included the assessment of maternal depression status, stress (general life stress and food insecurity stress), social support and demographic information (parent's education, family size, family economic status, etc.), and infant anthropometric measures (weight and length). In the second phase, which was conducted between November 20-30, 2011, after calculating depression scores of mothers, out of the original sample only 83 mothers (n=40 with lowest depression symptoms, EPDS score <13 and n= 43 with highest depression symptoms, EPDS score ≥13) were recruited for videotaping mother-infant interaction and testing visual information processing (visual habituation test). The mothers were invited by the community health workers to the community centers, and all data collection took place in the community centers of each research site. The selection of phase II sample was conducted using EPDS total scores of each mother. First, the EPDS total score for each mother of phase I sample (N=201) was computed. Because of the infrequency of scores below 13 (low depression), all mothers with EPDS scores of 12 and lower were recruited (n = 40). For the high

depression group mothers with the highest EPDS total scores above 13 (n=43) were recruited; only one mother had a score of 14 with all other mothers having higher scores. Thirteen was a cut-point for high/low depressive symptoms in the 10-item scale (Cox, Holden, & Sagovsky, 1987) and the current grouping followed this classification rule during sample selection. However, the final sample size was reduced to 73, because 6 mother-infant dyads from low depression group and 4 mother-infant dyads from high depression group did not show up for the second phase of data collection (for mother-infant interaction and visual habituation testing). The return rate was 87.95% (73/83). The return rate for depressed mothers was 39/43 (91%) and the return rate for non-depressed mothers was 34/40 (85%).

In all steps of participant selection, community leaders and community health workers collaborated by indicating free days in which mothers were not involved in other community programs and inviting each mother to community center for recruitment. The following steps were used during participant selection: (1) the researcher first visited the community leaders and administrators and presented letters written by Wolayita zone administration seeking collaboration of community leaders and administrators; (2) using the letters, the researcher introduced himself and his research design to the community leaders and health workers, and employed community health workers to call mother-infant dyads to community centers; (3) 201 mothers with their infants (age 6-17 months) were recruited in the first round. Mothers who were under age 18 years, or whose infants were younger than 8 months or older than 17 months, or who brought sick infants were excluded from the study.

The study was conducted after ethical clearance was obtained from Oklahoma

State University (USA) and Hawassa University (Ethiopia). In addition, approval letters were obtained from different administrative hierarchies (SNNPR, Wolayita zone and Soddo-Zuriya county) before visiting the community centers. Each mother was asked whether she agreed to volunteer to participate in the study, and her agreement was recorded on an audio-recorder during the recruitment time. All of the invited mothers agreed to voluntarily participate in the study; none of them disagreed after they were explained about the research design.

Data from the total sample of 201 mothers and infants were examined. First, data from mothers who completed questionnaires but did not remain for infant anthropometric procedures ($n = 4$) were deleted. Second, the remaining 197 participants were examined to see whether any of the infant anthropometric values indicated the possibility of measurement error (biologically impossible value) or a very sick infant. Based on this careful inspection and consultation with Dr. Tay Kennedy in the Department of Nutrition Sciences, data from two infants were removed from the final data set ($N = 195$) -- one with length and one with weight wrongly recorded during data collection. Further examination of the data revealed one infant who was an outlier on weight for length (WLZ = 6.85, which is approximately 2 SD above all other infants) was deleted. One mother, who did not have EPDS score, was also omitted from the analysis. Thus, the final sample in phase I was $N = 193$ mother-infant dyads.

3.2. Instruments and data collection procedures

Data collection was carried out in two rounds. In the first round (phase I), verifying inclusion criteria (age of mother, age of infant, whether the infant is well or ill), maternal completion of the informed consent form, maternal completion of the

demographic interviews, the Edinburgh Postpartum Depression Scale (EPDS), the Life Stress Scale (LSS), Household Food Insecurity Access Scale (HFIAS), Social Support Scale, and measurement of mothers' and infants' lengths and weights were conducted. In the second round (phase II), videotaping of mother-infant interaction and testing infant's recognition memory (Visual Paired Comparison) were conducted. For videotaping of mother-infant interaction and testing recognition memory, out of the sample of 201, only 83 mother-infant dyads (40 mothers with lowest depressive symptoms EPDS score $\leq$ 12 and 43 mothers with highest depressive symptoms EPDS score > 13) were selected. As noted above, the sample size was reduced to 73 because 10 participants did not show up for phase II data collection. After the data were collected, when the reliability of the current sample was computed, it was found that the reliability for the EPDS 10-item scale was low. Examination of reliability diagnostics indicated that the reliability would be acceptable if the first two items of the scale, which were suggested to be poor items in previous Ethiopian research (Tesfaye, Hanlon, Wondimagegn, & Alem, 2010) were omitted from the scale for the final analysis (see further discussion in measures section below).Thus, the final analysis was conducted on an 8-item EPDS scale, which has acceptable reliability, in phase I and phase II, Cronbach's α =.65 and .75, respectively.

In both sessions, the data were collected by the researcher and four assistant researchers. The assistant researchers were trained for two days. The first day of training involved interview administration techniques, ethical issues, and measuring length and weight of mothers and their babies. The second day was the practice time. The assistant researchers were assigned to take consent, interview and measure anthropometry of 4mother-infant dyads who were invited from the community center neighborhood. The

researcher and a home economics graduate, who had many years' of experience in collecting anthropometric data, trained the assistants, and evaluated and corrected while the assistants were practicing data collection procedures.

Video-taping of mother- infant interaction and memory testing was conducted by the principal researcher with one assistant. During the mother-infant interaction videotaping, the assistant brought the mother-infant dyads to the shelter and arranged the material for each episode. During the visual recognition memory testing, the same assistant seated the mother-infant dyads at the right distance and position from the stimuli. The principal researcher operated the camera and videotaped mother-infant interaction and conducted online coding during the visual habituation (recognition memory) test. In addition, the principal researcher supervised all data collection at the site.

All data collection took place in the community centers. Consent was read to a group of mothers (6 to 8) who were invited to the center each day, and their responses to participate or not to participate were recorded by asking each of the mothers by name. Interviews (EPDS, LSS, Food Insecurity Scale, Social Support Scale and demographic information) were administered individually by calling each mother-infant dyad to the quiet place in the center. Videotaping of mother-infant interaction and visual habituation test were done individually in a shelter prepared for this purpose in the community centers. The shelter was a 2m x 2m square space, prepared by connecting six poles with ropes and sheets. All sides are covered with sheets except the "door-like curtain" and a small opening to place the camera. The researcher operated the camera during the

interaction videotaping and the computer during the visual habituation testing (see details below for mother-infant interaction videotaping and for visual habituation testing).

3.2.1. Edinburgh Postpartum Depression Scale (EPDS). Maternal depression was assessed with the Edinburgh Postpartum Depression Scale (EPDS: Cox, Holden, & Sagovsky, 1987) adapted to Ethiopian culture. The EPDS consists of 10 short statements rated on a four-point Likert scale, ranging from 0 (least or no depressive symptom) to 3 (most severe depressive symptom). Although Hanlon, Medhin, Alem, Araya, Abdulahi, et al. (2009) questioned the validity of EPDS in Ethiopian culture, many other studies from different cultures of the world and the most recent study in Ethiopia with an urban population (Tesfaye, Hanlon, Wondmagen & Alem, 2010) reported that EPDS is a valid instrument to measure maternal depressive symptoms. For this study, the EPDS was translated from English into local Wolayita language (Wolayitigna). Mothers were interviewed in the community centers by trained research assistants who speak Wolayitigna and have experience in field work with mothers and infants (see Appendix A). The reliability of EPDS in phase 1(N=193) and in phase 2 was Cronbach's α =.51 and .68 respectively. Because the reliability of the scale was low, I examined the reliability diagnostics for “alpha if item deleted” to determine whether one or two items should be deleted. I deleted the first two items of the scale – (1.) I have been able to laugh and see the funny side of things; (2.) I have looked forward with enjoyment to things -- which had previously been suggested to be poor items in Ethiopian research (Tesfaye, Hanlon, Wondimagegn, & Alem, 2010) and which were identified by the reliability diagnostics as the two items that, when deleted, would lead to the greatest increase in reliability of the

scale. The reliability of the remaining 8 EPDS items in phase 1 (*N*=193) and in phase 2 (*n*=73) was Cronbach's α =.65 and .75, respectively.

3.2.2. Maternal stress scales. Maternal stress was assessed with two different measures: General life stress scale (LSS) and Household Food Insecurity Access Scale (HFIAS).

General life stress was assessed with 31 items adapted from Holmes-Rahe Social Readjustment Scale (Holmes & Rahe, 1967). The original scale consisted of 41 statements about stressful life events that may have occurred to the person in the last 12 months. This scale has been used with community samples in different cultures of the Developing World, and in Ethiopia (Tafari, Aboud & Larson, 1991; Hadley et al., 2008), and was reported to be a valid instrument. As suggested by previous researchers (Hadley et al., 2008), after the scrutiny of pilot data, 10 items which had no meaning in Wolayita culture (e.g., high mortgage and low mortgage) were removed because there is no mortgage service in the area; "trouble with boss" and "change of work time and condition" were removed, also, for there is no employment opportunity for the mothers outside of their own farms. Thus for the current use, 31 items were translated into Wolayita language (see Appendix B) and administered to mothers by trained interviewers. Each item of the Life Stress Scale (LSS) rated in a binary format in which 'Yes' coded 1 indicating that the participant have experienced the stressful event and 'No' coded 0 showing that the participant did not have the experience of the event. The reliability of LSS in phase 1(*N*=193) and in phase 2 (*n*=73) was Cronbach's α =.78 and .80 respectively.

Food insecurity stress was assessed with Household Food Insecurity Access Scale (HFIAS: Swindale & Bilinsky, 2006). HFIAS, a nine item scale, which has been widely used in Ethiopia (e.g., Regassa & Stoecker, 2012), was translated into Wolayitigna language (see Appendix C) and administered to mothers by trained interviewers. HFAIS was rated on a five-point Likert scale ranging from 0 (none of the time had food insecurity) to 4 (almost always had food insecurity). The reliability of HFIAS in phase 1(N=193) and in phase 2 (n=73) was the same: Cronbach's α=.77.

3.2.3. Maternal social support. Social support was assessed with two scales, the Multidimensional Scale of Perceived Social Support (Zimet et al., 1988) which has 12 items and the social support battery (Sherbourne & Stewart, 1991) which consists of 20 items. We used two scales because in the pilot study we found the reliability of Multidimensional Scale of Perceived Social Support (Zimet et al., 1988) was low (Cronbach's α= .67). For the main study, both scales were translated into Wolayita language and administered to mothers by assistant interviewers (see Appendix D). The items on each scale were rated on a five-point Likert scale ranging from no/never received support (0) to almost always received support from others (4). The reliability of the social support battery (Sherbourne & Stewart, 1991) in phase 1 (N=193) and in phase 2 (n=73) was Cronbach's α=.90 and .92 respectively. The reliability of Multidimensional Scale of Perceived Social Support (Zimet et al., 1988) was in phase 1, Cronbach's α=.87, and in phase 2, Cronbach's α=.86.

3.2.4. Socio-demographic information. Mothers were interviewed with a structured questionnaire. Demographic questions included parents' education, family size, marital status, religious affiliation (and church attendance), family socio-economic

status, milk-and meat-producing-animal ownership, mother's age, infant's age and birth order, whether paternal and maternal grandmothers live in the same house or not, access to health care clinics, and infant immunization (Appendix E).

Family socio-economic status was assessed using three different indicators: Material assets, milk- and meat-producing-animal ownership and subjective SES measure (SES ladder). This methodology has been widely used in developing countries, particularly with rural families, where household income and expenditures cannot be clearly identified because of lack of fixed daily, biweekly or monthly income source (Hadley et al., 2008).

Material assets and related possessions included disposable assets (radio/tape-recorder, bed, umbrella, shoes, watch, gold, torch/flash light, plough-animal), house quality (number of rooms), water access (piped water /river), toilet use (private toilet/ or open space). Mothers were asked whether they own radio/tape-recorder, bed, umbrella, shoes, watch, gold, torch/flash light, private latrine, and plow-animals using a binary format (1= Yes; 0= No). The variable, household material assets, was created by summing the responses of each mother to the above nine household items. House quality question included whether the family has many rooms or live in one room (more than 1 room= 1; one room= 0). Water and toilet access included questions that indicate whether the family uses protected public or private wells and springs as water source (coded 1) or river (coded 0) and using private or public toilet (coded 1) or open space and bushes (coded 0).

Cattle and other animal ownership included the ownership of cows, oxen, goats, sheep, horses, mules, and donkeys. Mothers were asked the type and number of animals

they own. Livestock ownership scale was created by adding cows, oxen, goats, sheep, horses, mules and donkeys. Poultry was not included in the animal ownership scale, because it was the cheapest animal in the area and cannot be used to indicate the economic status of the households (see Appendix E).

MacArthur Scale of Subjective Social Status (SES *ladder)* used by Hadley et al (2008) in south western Ethiopia was administered to mothers in their own language (Wolayita language). Each mother was presented with a picture of a ladder and asked to place herself on the ladder relative to the people, those who have the most and those who have the least amount of wealth in her own community. The ladder consists of 10 steps (Appendix G). The mothers' responses were coded from 1 to 10.

3.2.5. Videotaping mother-infant interaction. Mother-infant interaction was videotaped during five episodes each of which lasted for one minute. Episode 1 included free play of mother with her infant without toys: the mother was instructed to play by talking, singing or playing peak-a-boo game. Episodes 2 through 5 included infant play with age-appropriate toys selected from Bayley Scales of Infant Development BSID-II (Appendix F). The toys used were a cup and four tennis balls (Episode 2), a car (Episode 3), two dolls with string (Episode 4) and a basket of play materials including a cup, four tennis balls, car and dolls (Episode 5). Videotaping of mother-infant interaction was done by the researcher and one assistant specially trained by the researcher for this purpose. For the videotaping task, one participating mother-infant dyad at a time was invited into the temporary data-collection shelter (poles and sheets were connected by large pins and ropes to prevent attention distraction by others while the participants were being videotaped). A camera was placed at the appropriate distance, with only the lens

visible in the covered space, to record the mother-infant interaction. The camera operator stood outside of the shelter and adjusted the camera to focus on the mother and her infant. The mother and her infant were seated on a mat side by side, facing the camera. The researcher, who is fluent in Wolayita language (local language), instructed the mother to play with her infant in each episode as she would at home. The videotaping process started simultaneously when the episode began and ended when the episode terminates. For Episode 1 (1 minute), this instruction was given "You can relax and play with your infant as you do at home: games like peak-a-boo, talking or singing may be used." For Episode 2 through 5 (4 minutes), the assistant entered into the shelter and placed age-appropriate toys on the mat, and instructed the mother to play with her infant by using the toys. The assistant left the shelter after saying, "You can play with your infant by using toys as you do at home." The mother-infant interaction in all 5 episodes was videotaped, and later in the lab, coded for maternal and infant behaviors (e.g., maternal intrusiveness, responsiveness, behavioral attention focus, and warmth and sensitivity; and infant crying, vocalization, distress and activity level). Each of the maternal and infant behaviors was defined in the coding manual. Please see attached coding manual developed for this project (Appendix H).

Coding of mother-infant interaction was done in the Parenting, Micronutrients and Social and Cognitive Child Outcomes Lab, in Human Development and Family Science department by the researcher and one trained Graduate Assistant. The coding was conducted by strictly following the definitions of maternal and infant behaviors given in the manual. The coders' reliability was computed for 36 subjects independently coded by two coders. The coders' agreements for each of the maternal and infant

behaviors were the following: 1) Maternal behaviors: maternal intrusiveness, *r*= .41; maternal positive affect, *r*= .79; maternal warmth and sensitivity, *r*= .45; and maternal behavioral attention focus, *r*= .65 (in Episode 3). 2) Infant behaviors: infant cry, *r*= .72; infant vocalizations, *r*= .90; infant unhappy face, *r*=.85; and infant distress, *r*=.72.

3.2.6. Anthropometric assessment. All anthropometric measurements were taken at the community centers by the researcher and two trained research assistants, who participated in different nutritional survey research projects conducted in the region. The researcher was also trained to conduct anthropometric measures during the pilot data collection in Ethiopia in summer 2010, and collected pilot data with two other research assistants from a sample of 64 subjects.

The community workers invited all mothers with their infants (age 8-17 months) to the community center. In the center, the research team greeted the mothers and told them to sit in order of their arrival at the center. Before the anthropometric measurement, the team asked each mother the age of her infant and her own age. Mothers' responses of their infants' ages were verified using both physical assessments and event-referenced counting method. Physical assessments, including physical development milestones achieved by the infant, whether the infant crawls independently and stand using chairs and tables, and the number of teeth he/she has grown, were assessed. Infants who can crawl and stand with support and who had grown the upper and the lower incisors (at least 4 upper and 2 lower teeth) passed the preliminary assessment (Ferguson, Scott & Bakwin, 1957). Event-referenced age counting method was used with mothers whose infants passed the physical assessments. Since there was no fixed month-based counting system in Wolayita culture, the team asked the mothers whether their delivery was before

or after important events in their culture. Two historical events were used as point of reference: Inqutatash and Meskel. In Ethiopia Inqutatash and Meskel are spectacular national holidays celebrated by all people of the country. During the data collection year (2011), Inqutatash, the Ethiopian New year, was celebrated on September 1 , 2004 Ethiopian calendar (September 11, 2011 Gregorian calendar) and Meskel, the discovery of the true Cross, the Cross on which Christ was crucified, was celebrated on September 17, 2004 Ethiopian calendar (September 28, 2011 Gregorian calendar). Using this two holidays as point of reference, the team asked mothers whether their delivery was before or after each of these holidays.. Using each mother's report, the team identified the date of birth by counting back or forth from the two holidays. Later, we converted the birth date of each infant from Ethiopian calendar to Gregorian calendar using online calendar convertor. (http://www.gebeya.net/dateconverter.aspx).

Weights of infants and mothers were measured with the digital scale. The scale was calibrated for its accuracy every time at the beginning of the day of data collection. Every day before starting the data collection, the researcher and his assistant (home-economics graduate) checked the accuracy of the scale by measuring their weights. In addition, before taking the measure of each subject, the research team checked that the scale read zero. Once the digital measure was ready (shows zero), the assistant took the infant from the mother and told her to stand on the scale after removing shoes and additional clothes that she was using to carry the infant on the back. Each mother's weight was measured twice to the nearest .01 kg and the average was used for the final data set. After the mother's measurement was completed, the assistant gave the infant back to the mother and told her to stand on the scale again carrying her infant (the infant

was dressed in a light t-shirt given as an incentive for the participation). The measurement was taken twice for each participant, and later, the researcher computed each infant's weight by subtracting the mother's weight from the total. Each measure was taken rounding to the nearest .01 kg and the average of the two measures was used for the final infant data.

Length of the infant and the mother was measured using ShorrBoard Portable Wooden Stadiometer (Shorr Productions, Olney, MD, USA) with wooden base and movable piece to indicate different length/height. Both heights, the infant's and the mother's, were measured with the same type of board, which was made for double purpose, for measuring infant length in recumbent position or by increasing its length for measuring adult height in a standing position. Infant length was measured in a recumbent position using this measurement. Two trained assistant researchers, who participated in several nutritional survey studies, measured the infants' length and the mothers' height. One assistant placed the infant on the board adjusting his/her head to the right position on the board and the other adjusted the infant's body and legs to lie straight on the board and the bottom of both feet touch the movable piece of the board, and read the length (cm) from the board adjacent to the movable piece. The mother's height was measured with the same type of board with increased length and mounted on a smooth floor appropriate for measuring adult height in a standing position. Before the measurement, the research assistant took the infant from the mother and told her to stand barefoot straight on the right side of the board facing 90^0 right forward to the side of the researcher, not to the wall. After the assistant had checked that the mother was standing in the right position, then she read the mother's height using a pointer to link the top of mother's head with the

height (cm) indicator of the board. The measurement was taken twice for each participant and the average was computed because the difference between the two measurements never exceeded .05 cm for any of the mothers. The two measures were averaged.

Later, the following outcome variables were derived using the infants' and mothers' weight and length measures.

- Maternal body mass index (BMI) was calculated by dividing weight (kg) by the square of height (m^2), i.e., BMI = kg/ m^2
- Z-scores for infant weight-for-age (WAZ), length-for-age (LAZ), weight-for-length (WLZ), and BMI-for-age derived using the WHO Anthro (version 3.2.2, January 2011) and macros online software (http://www.who.int/childgrowth/software/en/.

The weight and length measures were first converted entering individual measures one at a time as the anthropometric calculator required and later we found the possibility of converting the whole data at one entry, i.e., the data were saved in SPSS dBase file and were converted with use of Nutritional Survey software available from the same site.

3.2.7. Visual habituation (recognition memory) test

Infants' cognitive performance (recognition memory) was tested using similar methods, material and procedures suggested by Colombo and Mitchel (2009) and Mitchell, O'Brien & Horowitz (1986).

3.2.7.1. Apparatus, stimuli and procedure

The infants were tested in a 2m x 2m shelter created for this purpose. The shelter was formed by connecting 6 metal poles with sheets by using large pins and ropes. In the

center of one side of the wall, at a proper position for the infant to watch the stimulus, a 0. 7m x 0.7m translucent screen made up of sheet was suspended. To capture infant's attention fixation, a small size webcam camera was positioned on the wall, hiding all other parts except the lenses. The projector was placed beside the left side of the mother with a tripod, in a position where the stimulus is projected in a straight/ undistorted way. There were two laptop computers connected to the projector outside of the shelter. One of the computers was programmed with a visual habituation program designed to send the stimulus to the projector when connected and to code the infant's fixations toward the stimuli (number and duration of looks) online. The image of the infant's face captured by the webcam was projected to the other laptop and was used to observe infant's attention focus (fixation of look) while she/he was watching the stimuli. The stimuli were eight human faces (four female and four male) developed by taking pictures of volunteer Ethiopian students attending the graduate college at Oklahoma State University in Spring 2011). Each picture was of the neck and head with a blank, emotionless facial expression. From these eight faces the researcher randomly selected two (one male and one female) to test each infant participant.

Before each mother-infant dyad was invited to the shelter, the researcher made all materials and procedures ready for the recognition memory procedure. That is, he placed a chair, on which the mother was to be seated, in the right position and distance about 60-70 cm away from the wall (screen) and pretested whether the computers and the projector worked correctly, and that the camera could capture infant's face at the correct angle, by asking his assistant to sit facing the screen in the position to be occupied by the mother and infant. Once the checking of the equipment was completed, the researcher turned the

computer program to the "ready" position. As soon as the mother and her baby were seated (the baby seated on the lap of the mother) in the right position and the infant was ready (not crying or breastfeeding), the researcher began the test by clicking the "ready" button on the computer. The other computer, which received live pictures from webcam camera, allowed the researcher to decide whether the infant was fixating on the stimulus or not. The infant was deemed to be fixating the stimulus if the reflection of that stimulus could be seen in the pupil of the infant's eye. When the infant was fixating on the stimulus, the experimenter depressed and held down the left mouse key, which allowed the first laptop computer to record the duration of the fixation. When the infant looked away (i.e., the reflection of the stimulus was no longer seen in the infant's pupil), the experimenter released the mouse key.

The visual habituation/recognition memory test has two phases: familiarization phase and test phase. During the familiarization phase, one human face, which was randomly selected from eight Ethiopian faces (four male and four female), was repeatedly presented on the screen placed approximately 60-70 cm away from the infant. The stimulus (human face) was presented until the infant reached the criterion, which consisted of two consecutive looks, each of which was $\geq$ 50% reduction from the mean of the two previous longest looks. The presentation was automatically controlled by the computer program. If the infant looked away from the screen for at least 1 second, the presentation terminated for 2 seconds, at the end of which, the stimulus reappeared and when the infant turned to the screen, the presentation continued again until the infant looked away. The coding of valid looks (infant looks that focused on the familiarization stimulus for 1-second and more) was accomplished with a left click on the computer

mouse. Every time when the infant looked away from the stimulus, the coding was terminated by releasing the button and when the infant looked at the stimulus, the coding continued again with a left click of the mouse. As soon as the habituation criterion was met, the program terminated and after 2-second pause the recognition memory test started.

During the recognition memory test phase, two stimuli (novel face and familiar face) were presented simultaneously side by side until a total of 5 seconds of looking at either or both of the two faces was recorded. When this criterion was met, the screen went blank for 1 second and the position of the faces was reversed until 5 more seconds of looking time was accrued to control for any position preference effect. The coding was accomplished by pressing the right mouse button when the infant looked at the right stimulus and the left mouse button when the infant looked at the left stimulus. Once the coding was completed, the output (duration of each look during the familiarization phase and the test phase and number of shifts from one stimulus to the other during the test phase) was automatically saved into the computer.

Later, the data were summarized as number of looks, longest look, and sum of looks from the familiarization phase and recognition memory (novelty preference) from the test phase. Recognition memory was computed by dividing the duration of looks at the novel stimulus by the total duration of looks at both the novel and the familiar stimuli and multiplying by 100 (Rose, 1994; Kennedy et al., 2008).

The coder's reliability for visual habituation test was not computed because the coding was conducted online. However, before the coder had gone to Ethiopia, he practiced the coding procedures in the Department of Psychology, OSU, for more than 20

hours (for two weeks, 2 hours/day) using previously recorded visual habituation test videos of 6- and 9- month-old infants until he achieved 99% agreement in his coding of the same video coded previously by experienced expert coders.

3.3. Data analysis

The data were analyzed with IBM SPSS Statistics version 19.0. The analysis will be discussed for each hypothesis below.

Hypothesis 1: Maternal depression will be significantly and negatively associated with each infant anthropometric measure: weight-for-length, weight-for-age, and length-for-age).

This hypothesis was evaluated with bivariate correlations and multiple regression (to control for covariates).

Hypothesis 2: The relation between maternal depression and infant outcomes is moderated by other risk factors such that the association will only be significant when other risk factors are high: low maternal BMI, male gender of infants, low maternal social support, low maternal economic assets (SES), and high food insecurity.

This hypothesis was evaluated with hierarchical regression. The centered predictor and dichotomous moderator were entered in the first block of the regression, followed by the multiplicative interaction term in the second block.

Hypothesis 3: Food insecurity stress and stressful life events will be significantly and negatively associated with infant outcomes.

This hypothesis was evaluated with bivariate correlations and multiple regression (to control for covariates).

Hypothesis 4: Maternal depressive symptoms are related to maternal behaviors toward infants during play or caregiving.

This hypothesis was evaluated with bivariate correlation and multiple regression (to control for covariates).

Hypothesis 5: The relation between maternal depressive symptoms and maternal behaviors is moderated by other risk factors: low maternal BMI, infant gender, low maternal social support, low maternal economic assets (SES), and high food insecurity.

This hypothesis was evaluated with hierarchical regression. The centered predictor and dichotomous moderator were entered in the first block of the regression and then I will enter the interaction term.

Hypothesis 6: Compared to infants with normal growth, stunted, wasted, and underweight infants will have significantly lower scores on measures of recognition memory.

This hypothesis was evaluated separately for each group (stunted versus not stunted; wasted versus not wasted; underweight versus not underweight). I conducted an analysis of variance (ANOVA) for each comparison.

Hypothesis 7: Stunting, wasting, and underweight classification and maternal depression classification interact to impact measures of recognition memory.

A two by two (two depression groups x two stunting/normal or underweight/normal or wasted/normal) ANOVA was computed to assess whether maternal depression effects on infant recognition memory were moderated by infant growth variables (the indicator of infants nutrition status).

Hypothesis 8: Positive maternal and infant behaviors during interaction will be positively correlated with novelty preference and negatively correlated with longest look during familiarization and the reverse will be true for negative maternal and infant behaviors and maternal depression (Note: longest look is an indicator of low information processing speed because many studies indicated that short lookers, compared to long lookers, had briefer looks, exhibited more shifts and more distributed attention which enabled them process information faster: Colombo & Mitchell, 2004; Jankowski & Rose, 1997; Harel, Gordon, Geva, & Feldman, 2011.)

This hypothesis was evaluated with bivariate correlations and multiple regression (to control for covariates).

The significance level of each analysis will be tested with $\alpha = .05$.

CHAPTER IV

RESULTS

Overview

The results of data analyses are presented in this section. Before each analysis and hypothesis test, the demographic characteristics and the descriptive statistics for predictor and outcome variables for phase I and phase II are summarized.

Demographic Characteristics (Phase I)

A sample of 193 mother-infant dyads was included in the phase I analysis. Although the original sample size was 201, due to the reasons described in chapter three, one infant with biologically impossible weight, one with biologically impossible length, one outlier on weight for length (approximately 2 SD above all other participants), and five participants with incomplete data (1 with missing EPDS questionnaire data and 4 with missing infant anthropometry) were excluded from the analysis. In some analyses, because of incomplete responses made to questionnaire items, the sample size was further reduced below 193 (see Table 1 for sample size per measure).

The participating mothers were relatively young with an average age of 27.4 years, and their infants were 8-17 months (mean age of 11.6 months) of age. Ninety-four male (48.7%) and 99 (51.3%) female infants participated with their mothers. Almost all

mothers (97.4%) were married and had a large family; including both children and adults the mean family size was 5.7). The mothers' education level was very low. About 68% of mothers had only completed grade 1 or had no education at all, and 92.2% had no formal schooling beyond grade 6.

The demographic information indicated that the majority of the participants were poor farmers who owned small plots of land (84.8%) and one or no livestock (83%). Poverty is also confirmed by the fact that 30.9% of the sample owned one or no household material assets out of the 9 items, including radio/tape-recorder, torch, bed, umbrella, etc. They were living in poor housing conditions: 55% lived in houses with grass/straw roofs, 50.5% had a one-room house, and 73.6% participants used unprotected sources of water (rivers) for drinking and other purposes (Table 1).

Descriptive statistics for Predictor and Moderator Variables (Phase I)

Descriptive statistics for predictor and moderator variables are presented in Table 2. The participants' total EPDS scores (based on items 3 to 10), measuring maternal depressive symptoms, ranged between 1 and 18, with average scores of mean 10.07 and median 10. Maternal experiences of life stress ranged between 0-25 with mean 13.52 and median14, and food insecurity stress ranged between 0 and 25 with mean 18.11 and median18. The two measures of perceived maternal social support, Social Support_{20} and Social $\text{Support}_{12,}$ had means of 26.31, 18.94 and medians of 26, 19, respectively. Maternal Body Mass Index (BMI), which is the indicator of maternal nutrition status, had mean 20.20 and median 20.13 with minimum 15.08 and maximum 25.44 BMI. The standard cut-point for low BMI is below 18.5 or below 19, indicating poor maternal

nutrition status/low BMI). We classified all mothers with BMI below19 into low BMI group, 54 (28%) met this criterion.

Descriptive Statistics for Outcome Variables (Phase I)

The outcome variables in phase 1were infant physical growth measures converted into standard Z-scores of weight-for-length, weight-for-age and length-for-age (WLZ, WAZ and LAZ). The sample mean for infant WLZ, WAZ and LAZ were -.15 (SD=1.38), -.60 (SD=1.49) and -.74 (SD=2.50), respectively (see Table 3).

Descriptive Statistics for Predictor and Outcome Variables (Phase II)

Sample demographics and predictors (phase II)

In the phase two study, 73 mothers (n=33 with EPDS ≤ 12 and 40 with EPDS > 13, omitting items 1 and 2 which were not consistent with the other 8) with their infants participated in videotaping of mother-infant interaction and visual habituation (novelty preference) testing. Because of missing responses, sample sizes vary across analyses

The participants' average age was 26 years (SD=3.9) and 11.79 months (SD = 1.52) for mothers and infants, respectively. Other descriptive statistics included: infant gender, male (n= 32; 44%) and female (n=41; 56%): physical growth grouping, 68 (93 %) normal WLZ, 5 (6.8%) wasted (WLZ≤ -2.0), 61 (83.6%) normal WAZ, 12 (16.4) underweight (WAZ ≤ -2.0), 47 (64.4%) normal LAZ, and 26 (35%) stunted infants.

Four maternal behaviors, maternal intrusiveness, positive affect, warmth and sensitivity, and attention focus were coded from videotaped infant-mother interactions. Four infant behaviors, vocalizations, activity level, unhappy face and distress were also

coded from the videotapes, which were recorded during a five minutes of play and caregiving episodes

Outcome Variables (Phase II)

Infant cognitive outcome variables in phase II study are the duration of the longest look (M=13.15, SD=7.44) and the novelty preference scores (M=.47, SD = .21). Out of the total participants with complete data (n=67), 33 (49.25%) demonstrated novelty preference (≥.50) but 34 (50.74%) did not (Note: Novelty preference score, the time spent looking at the novel stimulus divided by the time spent looking at both stimuli, the novel and the familiar, is the primary index of visual recognition memory. The scores are compared within or across groups and evaluated for whether they differ from chance, .50 or 50%--Kavesek, 2004; Rose & Feldman, Jeffery & Jankowski, 2003).

Tests of Hypotheses – Phase I

Hypothesis 1: Maternal depression will be significantly and negatively associated with each of the infant anthropometric outcomes, weight-for-length, weight-for-age and length-for-age (Phase 1).

Bivariate correlation analysis was conducted to test this hypothesis (Table 4). Maternal depression did not correlate with any infant outcome (weight-for-length, weight-for-age and length-for-age) Rather, the analysis revealed other important covariates, such as maternal low BMI r=-.15, p <.05, infant age r=-.16, p < .05) and food insecurity, r=-.20, p <.01, were significantly and negatively correlated with infant weight-for-length(WLZ), indicating that the lower the maternal BMI, the lower the infant

WLZ, and the higher the food insecurity the lower the infant WLZ. Infant WLZ was found to decline with increasing age, the higher the age the lower WLZ. The results further revealed variables significantly associated with infant weight-for-age (WAZ), such as mother's education, r=.21, p <.01, household assets, r= .18, p<. 05. The higher the maternal education and household assets, the heavier the infants. Length-for-age (LAZ) was also significantly and positively predicted by social $Support_{20}$, r= .15, p = .047, and mother's education, r=.18, p = .013. Infant LAZ was also correlated with infant age, r = .14, p = .054. The greater the maternal education and the social support the longer the infant. Likewise, the increasing infant age was associated with increasing LAZ.

Because of the absence of findings pertaining to maternal depression, I asked an exploratory question about which variables best predicted infant growth measures. Multiple regression analyses were conducted to identify the relative contribution of each covariate to infant outcome (WLZ, WAZ or LAZ). In each model, I entered all variables that were correlated with the outcome variable (WLZ, WAZ or LAZ) at a significance level of $p < .10$ to determine which ones remained significant after controlling for the others. Since maternal depression was not significantly correlated with any of infant outcome measures (WLZ, WAZ or LAZ) in bivariate correlation, it was excluded from regression analyses.

The Regression Analyses results are presented in Table 5 through Table 7. In the first model, the model with WLZ as dependent variable, four variables, maternal body mass index (BMI), food insecurity, household asset and infant age were entered as predictor variables and infant WLZ as outcome variable. The results showed that the

model accounted for a significant amount of variance in infant WLZ model, R^2=.107, p<.001. That is, these four variables accounted for about 10.7% of the variance in the infant WLZ model. Except for household assets, β=.083, p>.05, all the other variables significantly predicted the infant outcome (WLZ): Food insecurity, β= -.215, p <.01, maternal low BMI, β= -.137, p <.05, and infant age, β= -.203, p<.01 (see Table 5).

In the second regression model, WAZ was entered as dependent variable with four predictor variables: maternal education, SES (measured by ladder), household assets and livestock. The model was significant, R^2=.062, p<.05, and accounted for about 6.2% of variance in infant WAZ. Among the four variables entered, only maternal education significantly predicted infant WAZ, β= .176, p<.05 (Table 6).

In the third regression model, infant LAZ was entered as dependent variable with Social $Support_{20}$, Social Support $_{12}$, infant age and maternal education. The model was significant, R^2=.065, p<.05, and predicted about 6.5% of variance in infant LAZ. In this model, maternal education was a significant predictor, β=.165, p< .05, and infant age approached significance level, β=.131, p< .08 (Table 7).

Hypothesis 2: The relation between maternal depression and infant outcomes is moderated by other risk factors such that the association will only be significant when other risk factors are high: low maternal BMI, infant gender, low maternal social support, low maternal economic assets (SES), and high food insecurity.

To assess whether the relation between maternal depression and infant outcomes was moderated by the hypothesized moderator variables, moderation analyses were conducted by dichotomizing each variable as high versus low. First, to create high and

low group of a variable, descriptive analysis for each moderator variable was conducted, and separate bivariate correlations were conducted for high and low groups, based both on the research literature and on the distribution of variables in the current study. If infant WAZ, LAZ, or WLZ in one group (low or high) significantly correlated with maternal depression and the correlation for the other group approached 0 or was in the opposite direction, then we evaluated this variable as a moderator in a traditional multiple regression analysis of moderation effects. By using this strategy, we found two variables, maternal BMI with cut- point 19 (BMI≤ 19 low and BMI > 19 high BMI group) and maternal social support, satisfied our criterion for moderation analysis. Household economic variables (assets and SES) and food insecurity when grouped into low and high did not reveal different patterns of correlations of infant WAZ, LAZ, and WLZ with maternal depression scores, and the same was true of infant gender. All these variables were excluded from further moderation analysis and post hoc tests.

Social support (Social Support$_{12}$) with a cut-off of 14 (≤ 14 low group and >14 high group) did differentiate correlations of the infant growth measures to maternal depression. The interaction between social support and maternal depression was significant for both WLZ, b= .317, p =.003 (see Figure 5) and WAZ, b= .286, p = .011 (see Figure 6).

Moderation analysis and post hoc tests (multiple regressions) were conducted to assess whether the link between maternal depression and infant outcome (WAZ or LAZ) was moderated by low maternal BMI (BMI < 19; n=54 or 28% of the mothers met this criterion). The analyses showed a significant interaction of maternal depression and low maternal BMI for WAZ and LAZ. For the analyses for WAZ, the main effect for the

maternal BMI moderator was b = .095, p =.688 and the main effect for centered EPDS was b = -.213, p = 004. The interaction effect for the BMI moderator and EPDS was b = .251, p = 004. For the analyses for LAZ, the main effect for the maternal BMI moderator was b = -.396, p =.321 and the main effect for centered EPDS was b = -.253, p = .040. The interaction effect for the BMI moderator and EPDS was b =.348, p = .017. For mothers with low BMI, increasing depression was significantly associated with decreasing infant weight and length (see Figures 1 and 2); for mothers with BMI $\geq$ 19, there was no association between maternal depression and infant WAZ or LAZ.

The moderation analysis by grouping mothers into low BMI group using the traditional designation of BMI < 18.5 as the criterion for low BMI, (n=35 or 18.1% of the sample met this criterion), also revealed similar results, i.e., maternal BMI significantly moderated the relation between maternal depression and infant WAZ and LAZ. In the WAZ model, the main effect for the maternal BMI moderator was b =.034, p = .901, and the main effect for centered EPDS was b = -.252, p= .011. The interaction effect for maternal BMI and EPDS was b = .257, p = .017. In the LAZ model, the main effect for maternal BMI was -.672, p = .148, the main effect for the centered EPDS was b = -.357, p = .030, and the interaction effect for maternal BMI and EPDS was b = .428, p = .018. For mothers with low BMI, the higher the depression the lower the infant WAZ and LAZ; for mothers with BMI $\geq$ 18.5, maternal depression had no significant effect on their infants' WAZ or LAZ (see Figures 3and 4).

Hypothesis 3: Food insecurity stress and stressful life events will be significantly and negatively associated with infant outcomes. - Phase I

This hypothesis was tested in the same bivariate correlation analysis conducted for testing hypothesis 1 above (see Table 4) because both food insecurity and life events stress measure one of the variables considered in the analysis. As indicated under hypothesis 1, food insecurity was significantly and negatively associated with infant WLZ, r=-.20, p <.01, When maternal food insecurity stress increased, infant WLZ score declined. Maternal life stress experience, however, was not associated with any of the three infant growth outcomes (Table 4).

To assess the relative contribution of food insecurity in WLZ model, regression analysis was conducted by simultaneously entering food insecurity with other covariates, maternal low BMI, infant age and household assets. The model was significant, R^2=.107, p<.001; food insecurity, maternal BMI, infant age and household assets together predicted 10.7% of variance in WLZ (Table 5). Food insecurity significantly and negatively predicted infant WLZ, β=-.215, p <.01.

Hypothesis 4: Maternal depressive symptoms are related to maternal behaviors toward infants during play or caregiving.

Bivariate correlation was conducted to assess whether maternal depressive symptoms were related to maternal behaviors during play or caregiving interactions. When EPDS total score was used, the results showed that maternal depression was not correlated with any maternal behaviors (Table 11). However, the analysis revealed that many other maternal characteristics were significantly correlated to observed maternal behaviors. The higher the food insecurity, the lower the maternal warmth and sensitivity, r=-.24, p <.05, and the lower the maternal intrusiveness, r=-.24, p <.05. The higher the

SES, the higher the maternal positive affect, $r = .27$, $p < .05$, the higher the maternal warmth and sensitivity, $r = .27$, $p < .05$, and the higher the maternal attention focus, $r = .41$, $p < .01$. The findings suggest that economic variables, including food insecurity and low SES place mothers at risk of poor quality of behavioral interaction with their infants during play and care episodes. It seems that food insecurity, which contributes to maternal nutritional deficiency, renders mothers more lethargic in both positive and negative behaviors, i.e., less warm and sensitive and less intrusive.

Because of the different criteria used in Ethiopia to classify mothers as depressed and not depressed, the association of maternal depression to maternal behaviors was explored by grouping mothers into four depression groups: mothers with no depressive symptoms at all (EPDS score ≤ 7), mothers with mild depressive symptoms (EPDS score 8-10), mothers with medium level of depressive symptoms (EPDS score 11-13) and mothers with high depressive symptoms (EPDS score ≥ 14). This analysis indicated that maternal depression group was significantly and negatively associated to mother's positive affect, $r = -.25$, $p < .05$), i.e., the higher the maternal depression, the less positive was the mother during the interaction with her infant.

Hypothesis 5: The relation between maternal depressive symptoms and maternal behaviors is moderated by other risk factors: low maternal BMI, male gender, low maternal social support, low maternal economic assets (SES), and high food insecurity.

The moderation analyses revealed that the relation between maternal depression and maternal behaviors is moderated by maternal SES. To identify moderators, each of

the potential moderators was grouped into high and low with assessment of their frequencies. Social Support$_{12}$ was grouped into (≤14 low and >14 high), infant gender into (1 female and 2 male), low maternal BMI (≤19 and >19), assets (≤4 low and > 4 high), SES (≤2 low and >2 high), and food insecurity (≤ 15 low and >15 high). For low and high groups of each of the potential moderators correlations were conducted for maternal depression with maternal behaviors (intrusiveness, positive affect, warmth and sensitivity, and behavioral attention focus) to identify different patterns of correlations as described for hypothesis 2, but here for maternal depression and maternal behaviors. Then, multiple regressions were conducted to identify whether the interaction effect (maternal depression X the potential moderator variable) significantly predicts maternal behaviors. The result showed that maternal subjective grouping of their economic status (SES ladder) is a significant moderator linking maternal depression and maternal positive affect, $b = -.74$, $p < .05$. For high SES groups, increasing maternal depression is associated with low maternal positive affect expression during their play and caregiving interaction with infants. For the low SES group, the interaction term was not significant, i.e., increasing maternal depression had no clear effect on mothers within the low SES category, a group of mothers experiencing many risks. The other moderators were not correlated significantly in expected direction and were excluded from regression analyses.

Hypothesis 6: Compared to infants with normal growth, stunted, wasted, and underweight infants will have significantly lower scores on measures of longest look and recognition memory.

One Way Analyses of Variance (ANOVAs) were conducted to compare mean difference of novelty preference and longest look duration separately for normal growing infants with poor growing infants (normal versus stunted, normal versus underweight and normal versus wasted). The results indicated that mean difference in the duration of the longest look during familiarization for normal versus underweight was not significant, F (1, 71) = 1.10, $p > .05$ (Table, 12), but the novelty preference scores of this group was significantly different, F (1, 65) = 5.15, $p < .05$ (Table 13).The underweight group, compared to the normal weight group (M= .49, SD= .19), achieved lower novelty score total (M=.34, SD= .26) The mean differences between the normal versus stunted group were also compared for two outcome measures (longest look duration and novelty preference) by using One-Way ANOVAs. However, as the analyses showed, none of the means significantly differed between the normal and the stunted groups. The mean differences of longest look between normal and stunted group was not significant, F (1, 72) = .12, $p >.05$, and for this comparison, novelty preference scores also did not differ significantly F (1, 65) = .78, $p >.05$. The hypothesis comparing wasting group differences with normal group in both longest look and novelty preference scores was not tested due to the very small sample size of the wasted group (n=5)

Hypothesis 7: Stunting, wasting, and underweight classification and maternal depression classification interact to impact measures of recognition memory.

A two by two Analysis of Variance (2 maternal depression group X 2 infant physical growth groups) was used to assess whether the interaction between maternal depression and poor infant growth (wasting, underweight and stunting) had any effect on

infant longest look duration and novelty preference scores. However, the hypotheses for maternal depression by underweight and maternal depression by wasting interactions were not tested due to low sample size in the wasted group (n=5) and in the underweight group (n=12). Thus the sample size permitted a test only of the interaction of maternal depression by stunting (n=26) on both novelty preference and longest look. However each of the interactions was not significant, stunted by depression, $F(1, 63) = 1.91$, $p > .05$ and $F(1, 69) = .07$, $p > .05$, respectively.

Hypothesis 8: Positive maternal and infant behaviors during interaction will be positively correlated with novelty preference and negatively correlated with longest look and the reverse will be true for negative maternal and infant behaviors and maternal depression.

Bivariate correlation analysis was conducted to assess the relations of positive and negative maternal behaviors to infant longest look and novelty preference (Table 11). The analysis revealed that out of three positive maternal behaviors included in the analysis (maternal positive affect, maternal warmth and sensitivity, and maternal attention focus), only maternal positive affect was significantly and negatively correlated with infant longest look during habituation (familiarization phase), $r = -.246$, $p < .05$, indicating that the higher the maternal positive affect, the lower the infant longest look (the faster the infant information processing speed). None of the maternal positive behaviors were related to novelty preference (Table 11). Further exploration of covariates associated with longest look showed that different maternal characteristics, such as SES ladder, $r = -.323$, $p < .01$, and social support$_{12}$, $r = -.278$, $p < .05$, were negatively and significantly associated with longest look, i.e., the higher the SES and the more social support the

mother received, the shorter the length of the infant look (the faster the information processing speed of the infant) during the habituation test.

To evaluate the relation of maternal depression to infant longest look and novelty preference, the same depression groups were constructed as in the evaluation of hypothesis 4: no depressive symptoms (EPDS score ≤ 7), mild depressive symptoms (EPDS score 8-10), medium level of depressive symptoms (EPDS score 11-13), and high depressive symptoms (EPDS score ≥ 14). The higher the EPDS group, the longer the length of the longest look, $r = .277$, $p < .05$. The same pattern of results was true for the EPDS total score, $r = .221$, $p = .060$. (Other covariates correlated in expected directions, for example: food insecurity with longest look, $r = .30$, $p < .01$; social support$_{12}$, $r = -.28$, $p < .05$, SES ladder, $r = -.32$, $p < .01$.

Mediation analysis was conducted to assess whether the relation between maternal depression (measured with four EPDS groups) and infant longest look duration was mediated by maternal positive affect. According to Baron and Kenny (1986), the following three conditions must be fulfilled to test the mediation model: (1) The independent variable (e.g., maternal depression groups in the current study) must be significantly associated with the dependent variable (i.e., infant longest look), (2) The independent variable must be linked to the mediator variable (i.e., maternal positive affect) and, (3) The mediator variable must be significantly associated with the dependent variable. All the above three conditions were satisfied in the current study and this allowed conducting the mediation test. In the bivariate correlation analysis, the two variables, maternal depression groups ($r = .277$, $p < .05$) and maternal positive affect ($r = -.246$, $p < .05$) were found significantly correlated to infant longest look duration.

Maternal positive affect was also significantly correlated with maternal depression groups $r = -.249$, $p<.05$, which supports testing for mediation effect of maternal behavior (positive affect) on the link between maternal depression and infant information processing speed (duration of longest look) during the habituation test.

The mediation effect was tested by two multiple regression equations. First, the dependent variable (infant longest look duration) was regressed on the independent variable (maternal depression groups). Second, the dependent variable was regressed on the independent variable while controlling the effects of the mediator variable (maternal positive affect). According to Baron and Kenny (1982), full mediation occurs when the following two conditions are met in the second regression analysis: (1) The independent variable (maternal depression groups) no longer significantly predicts significant variance in the dependent variable (longest look); (2) The mediator variable (maternal positive affect) significantly predicts the dependent variable.

The analysis revealed that maternal positive affect did not mediate the link between maternal depression and infant longest look duration, because in the first equation, maternal depression groups explained about 7.7% of variance in the infant longest look duration, $R^2 = .077$, $p < .05$. But, in second equation, although the two variables, maternal depression groups and maternal positive affect, significantly predicted the longest look duration, $R^2 = .098$, $p < .05$, neither of these two variables alone reached significance. Moreover, the Sobel test for mediation is not significant, suggesting that either the Sobel test was too conservative to identify the effect with the current small sample size(n=73) or maternal positive affect probably does not mediate between depression and longest look.

Maternal intrusiveness during play and caregiving interactions was negatively and significantly correlated with infant novelty preference total score, r= -.26, p < .05, indicating that the higher the maternal intrusiveness the lower the infant novelty preference (recognition memory). In addition, two other variables, maternal nutrition status (BMI), r = .308, p < .01, and infant weight-for- age Z-score < 2 (underweight), r = -. 271, p < .05 were significantly associated with infant novelty preference total scores, i.e., the better the maternal nutrition status the higher the infant novelty score (recognition memory); and the more the underweight the infant the poorer his/her novelty score. The correlation analysis further revealed that out of the two positive infant behaviors (infant vocalizations and activity level) coded from videotapes of mother-infant interactions, infant vocalizations significantly and negatively correlated with longest look, r=-.24, p < .05, indicating that the higher the infant vocalizations, the lower the longest look duration (the faster the speed of information processing). Infant activity was neither associated with longest look nor with novelty preference total, r = -.16, p >.05 and r = .14, p >.05, respectively. None of the infants' negative behaviors was associated with either longest look or novelty preference. Multiple regression analysis with novelty preference total score as dependent variable and three predictors (maternal intrusiveness, maternal BMI and infant underweight) showed that these variables in aggregate significantly predicted infant novelty preference, R^2 = .224, p < .01, i.e., the model predicted about 22.4% of variance in infant novelty preference score. The significant predictors were maternal nutrition status, β = .290, p < .05, and maternal intrusiveness, β = -.300, p < .01, but the effect of infant underweight status did not reach a significance level, β = -.218, p > .07.

CHAPTER V

Discussion

The purpose of the study was to assess relations of maternal depression, stress, social support and socio-demographic factors, including maternal nutrition status (BMI), maternal education, family economic resources and subjective/perceived social status with mother-infant interaction and infant physical weight, length and recognition memory in Wolayita rural villages, Southern Ethiopia. Specifically, the study aimed to identify factors that might have contributed to the conflicting findings reported about the associations of maternal depression with infant outcomes in Africa, including Ethiopia. This is one of the first studies to test the possibility that unexamined moderators obscure the relation between depression and infant weight, length and cognition.

The following paragraphs discuss all hypotheses. In brief, hypotheses 2, 3, 5, 6 and 8 are supported or partially supported, but hypotheses 1, 4 and 7 are not supported.

Hypothesis 1: Maternal depression will be significantly and negatively associated with each of the infant anthropometric outcomes, weight-for-length, weight-for-age and length-for-age (Phase 1)

Hypothesis 1 was not supported. Maternal depression had no relation to any of the three infant growth measures. This finding was consistent with a few previous studies conducted in different countries, including Ethiopia. For example, longitudinal studies in Butajira, Southern Ethiopia, reported similar findings: maternal depression was not associated with weight and length of 12 months old infants (Servili et al., 2010), with birth weights (Hanlon et al., 2010), and with stunting and underweight measures of 6 and 12 months old infants (Medhin et al., 2010). Another study that was conducted on a large, representative sample selected from four different countries, including India, Pakistan, Peru and Ethiopia also found no relation between maternal depression and weights and heights of 6-18 months age infants in Ethiopia (Harpham, Hutly, Silva, & Abramsky, 2005). The current finding contradicts many studies reported from Southeast Asian countries, such as India (Harpham, Hutly, Silva & Abramsky, 2005; Patel et al., 2004), Pakistan (Rahman et al., 2004), Vietnam (WHO, 2007) and Bangladesh (Black et al 2009) which consistently found a negative association between maternal depression and infant physical growth (weight and length/height). The current finding is also in contrast with some studies conducted in Africa -- with Malawian, Nigerian, and Zambian studies that reported a significant association between increasing maternal depression and poor infant growth, low height- for- age (Adewuya et al. 2008; Ndokera & MacArthur, 2010; Patel et al., 2003; Stewart, et al. 2008), and with one Ethiopian study that found a negative association between maternal depression and overall infant development

(physical and motor skills) in 3- to 23-month-old infants in Gilgel Ghibe areas of south-central Ethiopia (Hadely et al., 2008), and associations between maternal depression and lower weight-for-age Z-scores (Hadley, Tessema & Muluneh, 2012). Thus, the current finding is in contrast with the most recent findings of Hadley and associates, and the reason for such difference may be explained by this study's evaluation of potential moderating factors as reported below in hypothesis 2.

Hypothesis 2: The relation between maternal depression and infant outcomes is moderated by other risk factors such that the association will only be significant when other risk factors are high: low maternal BMI, infant gender, low maternal social support, low maternal economic assets (SES), and high food insecurity (Phase 1)

This hypothesis is partially supported. Out of the five potential moderators, maternal BMI and maternal social support were found to be significant moderators of the relations of maternal depression to infant weight and length. Increasing maternal depression was associated with decreasing weight and length for infants whose mothers had low BMI. For infants whose mothers had normal BMI – defined as either BMI > 18.5 or BMI > 19 -- maternal depression had no significant effect on their weight (see Figures 1 and 4 for BMI > 18.5 and BMI > 19 criteria, respectively) and length (see Figures 2 and 3 for BMI > 18.5 and BMI > 19 criteria, respectively). To the best knowledge of the researcher, this study is the first to assess whether maternal nutritional status (BMI) moderates the relations of maternal depression to infant weight and length. A few of the previous studies, although they did not assess the maternal BMI as a moderator variable of the link between maternal depression and infant development, found that maternal low

BMI during pregnancy was associated with low birth weight (Frederick et al., 2008; Scholl et al., 2004) and in Kenya maternal BMI was found to be negatively associated with 0-6 months age infants weight (Bhargava, 2000). The current finding provides further support for the importance of maternal BMI in infant development by providing evidence that BMI is a moderator of the effects of maternal depression on infant weight and length. In the current study, maternal BMI $\geq$ 19 protected infants from the association of maternal depression with decreasing weight and length. This implies, as Wachs (2008) suggested, depressed mothers with poor nutrition status (low BMI) did not feed their infants adequately, or terminated breast feeding earlier or did not actively use all possible sources of food to fulfill the physiological needs of the growing infant. Thus, low maternal nutrition seems to exacerbate the effect of maternal depression on infant physical growth.

Like low BMI, low maternal social support moderated the association between maternal depression and infant growth, specifically WLZ (see Figure 5) and WAZ (see Figure 6).

Tests of the other hypothesized potential moderators (infant gender, low economic assets/SES, and high food insecurity were not significant and the hypothesis was not supported.

Hypothesis 3: Food insecurity stress and stressful life events will be significantly and negatively associated with infant growth outcomes (Phase I).

This hypothesis is partially supported. High food insecurity was associated with low infant weight-for-length (indicator of acute weight loss or wasting). This finding is consistent with previous findings. For example, a longitudinal study in Bangladesh found

that infants from food secure households showed greater weight and length gain from birth until 2 years compared to infants from high food insecure households (Saha, 2008), and in Tanzania evidence found positive association between food insecurity and infant stunting between age 6-36 months (Maseta, Kogi-Maqau & Omwega, 2008). Food insecurity is one of the major causes of infant stunting, wasting, and undernutrition in the world (UNICEF, 2009). Ethiopia is a country with high poverty rate -- about 38.9% of the population live below poverty, spend less than $1.25 a day (World Bank, 2005) and experience high food scarcity, for example, about 83% of the households had food insecurity in Sidama, southern Ethiopia, (Regassa &Stoecker, 2011). In the current study about 177 (91.7%) were food insecure, only 12 (6.2%) were food secure and 4 participants (2.1%) had incomplete responses to the food security measure. Food insecurity seems to be one of the major predictors of infant weight-for-length (WLZ), because it was a significant predictor of WLZ, even after controlling for other covariates, such as maternal nutrition status (BMI), household asset, and infant age.

Hypothesis 4: Maternal depressive symptoms are related to maternal behaviors toward infants during play or caregiving (Phase 2)

This hypothesis is partially supported. Continuous maternal depression scores on the EPDS were not associated with any of maternal behaviors studied, including maternal intrusiveness, maternal positive affect, maternal warmth and sensitivity, and maternal attention focus. The current finding contradicts some findings reported from other developing countries. Those studies found an association between maternal depression and poor quality of mother-infant interaction, for example less maternal responsiveness in Bangladesh (Black, et al., 2009) less sensitivity and more intrusiveness in South Africa

(Cooper et al., 1999). However, it is consistent with studies in other countries, for example, in Brazil, Fonseca, Silva and Otta (2010), and, in Germany, Sidor, Kunz, Schweyer, Eickhorst and Cierpka (2011), did not find any association between maternal depression and maternal sensitivity, responsiveness, or controlling behaviors. From different parts of the world, additional conflicting findings have been reported about the impacts of maternal depression on infant development and on maternal behaviors. For example, one study showed that depressed mothers of three-month old infants were more hostile, less affectionate, exhibited less positive affect and warmth, and were less engaged in play with their infants (Lovejoy, Graczyk & Neuman, 2000). Depressed mothers expressed less vocal and facial communication and less smiling to their infants (Righetti-Veltema, Conne-Perreard Bousquet & Manzano, 2002). Moreover, the behaviors of depressed mothers toward their infants are generally classified as negative, including intrusive, aggressive, and hostile or withdrawn/emotionally flat, with no sensitivity to infant needs and signals and positive behaviors, including low maternal positive affect, warmth and sensitivity, and behavioral and verbal attention focus (arranging play material in a teaching manner and creating conditions for infants to learn) during their interaction (for review, Field, 2010).

The question why the current study fails to replicate these findings is a question waiting answer in a future study of the ways in which cultural and contextual differences may contribute to the variability of previous findings. Although maternal depression did not correlate with maternal behaviors except positive affect, it was significantly and negatively correlated with economic status grouping (SES ladder) and SES was significantly and positively correlated with each of the maternal positive behaviors. The

higher the maternal SES the higher their positive affect expression to their infants, the greater their warmth and sensitivity to their infants cues and the more conditions they created for their infants to learn. Moreover, the SES ladder seems to be the major indictor of maternal economic and social status, because it was significantly and positively correlated with maternal education, household asset, livestock ownership, social support received by mothers and maternal nutritional status; but it was strongly and negatively correlated with maternal depression (both with EPDS total score and EPDS groups) and food insecurity. It was also moderately and negatively associated with family size. Thus one of the speculative answers for why continuous maternal depression scores did not affect many of maternal behaviors was that, perhaps, poor economic and social background of the mothers put the majority of them at risk for depression and might have reduced their ability to maintain their best parent-child relationship skills on a minute-by-minute and day-by-day level although the continuous scores were not related to behaviors during our semi-structured observation.

Although the continuous EPDS measure was not related to maternal behaviors, the grouping of EPDS scores into four groups – from nondepressed to high depressive symptons – was significantly inversely correlated with maternal positive affect such that the higher the depressive symptoms, the lower the positive affect in mother-infant interaction. Thus, the expected link between depression and maternal positive affect was found for the four groupings of depressive symptoms suggesting that in Ethiopia depression may be reflected not as a continuous measure but may be better measured with different thresholds.

Hypothesis 5: The relation *between maternal depressive symptoms and maternal behaviors is moderated by other risk factors: low maternal BMI, male gender, low maternal social support, low maternal economic assets (SES), and high food insecurity.*

This hypothesis is partially supported. Out of the five potential moderator variables (low maternal BMI, infant gender, low maternal social support, low assets and SES), only subjective economic status grouping (SES ladder) is found to moderate the link between maternal depression and positive affect (one of the maternal positive behaviors). Currently, there has been no study that tested economic and social factors moderating the effect of maternal depression on their behavior during play and caregiving interaction with infants. But, there are many theoretical models proposing the importance of the aforementioned, biological economic and social variables linking maternal depression to maternal behaviors. For example Engle and colleagues proposed that in order to give adequate care to their infants, mothers need good dietary intake, household food security, adequate economic resources and good psychological health, including low depression and stress status. The model indicated each of these variables had either moderating or mediating impact on the link between maternal care taking behaviors, available economic and psychological resources and child growth and development (Engle, Lhotska &Armstrong, 1997). In a system theory model, Wachs (2004, 2008) also emphasized that maternal psychological health and behaviors are directly or indirectly related to infant growth and development.

Hypothesis 6: Compared to infants with normal growth, stunted, wasted, and underweight infants will have significantly lower scores on measures of longest look and recognition memory (Phase 2).

This hypothesis partially supported. The novelty preference total scores of the underweight group are lower than the scores of normal weight group, indicating that poor physical growth, operationalized by underweight, has a negative effect on infant recognition memory ability (novelty preference). This finding is consistent with other previous findings. One study that compared novelty preference scores of normal and at-risk infants (infants with intra-uterine growth retardation) at age 7 months reported that normal infants demonstrated better novelty preference than did the at-risk group (Gotlieb, Biasini, and Bray, 1988). In Sidama, Ethiopia, Kennedy et al. (2008) found similar results for younger infants. Underweight infants, compared to normal weight, showed longer look duration (slower information processing speed) during the habituation phase, and stunted infants showed lower shift rate (a less commonly used indicator of recognition memory) both during the familiarization and the test phases, indicating significant link between poor physical development and infant cognition, both look duration and novelty preference. A longitudinal study with Peruvian infants and children age 6-18 months, and 4.5-6 years found stunting was associated with poor cognitive performances (Crookston, Dearden, Alder, Porucznik, Stanford et al., 2011). However, in the current study, both longest look and novelty preference scores did not differ between the stunted group and the normal length group, and longest look did not differ between the underweight and the normal weight group. Thus, the hypothesis comparing longest group in both stunted versus normal and underweight versus normal was not confirmed. The hypothesis comparing longest look and novelty preference between wasting group and normal group of infants was not tested due the small size of the wasted group (n=5).The researcher feels that small sample size (n=73) may have obscured the expected differences in

novelty preference and longest look duration between normal and poor physical growth groups (wasted, stunted and underweight)..

Hypothesis 7: Stunting, wasting, and underweight classification and maternal depression classification interact to impact measures of recognition memory.

This hypothesis is not supported. The output of a 2 X 2 ANOVA (maternal depression groups X stunted versus normal length group) revealed no interaction effect between the two independent variables on infant information processing speed or recognition memory. The current study was conducted to assess the mechanism linking poor physical growth to poor cognitive outcomes. However, the finding does not support our expectation. The interaction was not significant, i.e., the two independent variables (maternal depression and infant poor growth) do not interact in their influence upon infant's cognitive outcome (speed of information processing and recognition memory). Previous findings which assessed main (independent) effects of both maternal depression and poor physical growth on infant cognitive outcomes suggest that each of these variables had negative effect on infant outcomes. For example, Laus, Vels, Costa and Almeida (2011) noted that poor growth (underweight, wasting, and stunting) was associated with poor cognitive performance because poor growth is the indictor of undernutrition, and nutrition deficiency causes impaired brain development, including reduced brain cells and neuron, leading to poor cognitive performance. In contrast, many other researchers, suggest that the mechanism that links undernutrition (measured by poor growth indicators, WAZ, LAZ and WLZ) to cognitive development cannot be a single factor; the situation is complex, providing evidence that many food supplement programs provided to underweight, stunted and wasted children did not improve these children's

cognitive outcome. This is why, the investigation of mechanisms linking poor growth with cognitive outcomes is important. Because the small sample size might have resulted in insufficient statistical power future research examining the interaction between maternal depression and infant growth on measures of infant recognition memory is needed.

Hypothesis 8: Positive maternal and infant behaviors during interaction will be positively correlated with novelty preference and negatively correlated with longest look and the reverse will be true for negative maternal and infant behaviors (Phase 2).

This hypothesis is partially supported. Out of three positive maternal behaviors included in the study (maternal positive affect, maternal warmth and sensitivity and maternal attention focus), only maternal positive affect was associated with duration of infants' longest look. The higher the maternal positive affect the faster the infant processed information during the visual habituation familiarization phase, suggesting that positive mother-infant interaction may contribute to cognitive development at an early age. The current finding is consistent with previous findings; for example, maternal responsiveness and sensitivity to infant cues were associated with infant cognitive outcomes in infants and toddlers (Murray, 1996). The current study did explore the possibility that maternal positive affect served as a mediator between maternal depression (operationalized as four depressive symptom groups) and infant longest look. Although the criteria for mediation were met, the Sobel test was not significant. Thus, maternal positive affect as a mediator and mechanism could not be confirmed. Additional research is needed to explore this intriguing possibility.

Limitations

The study has three major limitations: (1) its small sample size (N=73) in phase 2 and a convenience sampling design are limitations. The sample was drawn from rural villages using a convenience sampling method, which involved contacting administrative units with offices located across main roads, which enabled the researcher easy access to the site for data collection. However, both the convenience sampling design and the small sample size of the study limit the generalizability of the finding to a larger population. (2) Lack of birth record system in the community was one major obstacle that the researcher team faced during data collection. Due to lack of birth date record, the infant age was determined by maternal reports confirmed by the assistant researchers' physical development assessments, but verification with birth dates was not possible. (3) Moreover, lack of birth weight records limits the conclusion whether difference in weight is due to prenatal or postnatal factors.

Future research

Future research should be conducted in a large representative sample to replicate the current findings before they are generalized to a larger population. Moreover, the current study has highlighted many interesting areas of future research. (1) Different potential moderators, which were not found to be significant here, need to be examined in a larger sample in the future. The researcher feels that conflicting findings reported by previous study about the associations of maternal depression with infant outcomes may

be resolved by carefully studying both moderating and mediating effects of different variables. The current study highlighted the possibility that maternal depression effects on infant development can vary within the same geographic and cultural environment due to the influence of moderating/intermediate variables, for example maternal BMI. Thus, future research needs to assess how these and other variables could have potential effects on the link between maternal depression and infant outcomes Conclusion

Conclusion

The study identified some of the mechanisms through which maternal depression is linked to infant physical and cognitive developmental outcomes. That is, maternal depression adversely affected infant physical development in infants whose mothers had nutritional deficiency (low BMI) or who saw themselves as receiving low social support from husbands, family and friends. Maternal depression had no major effect on physical growth of infants whose mothers were well-nourished or received high social support.

The direct path between maternal depression and infant information processing speed, as measured by the longest look duration in the habituation test (familiarization phase), was confirmed when continuous maternal EPDS scores were divided into four groups. However, this path was not mediated by positive affect based on the Sobel test Nonetheless, infants whose mother were less positive and more intrusive during play and caregiving interaction demonstrated poorer information processing ability (longer look duration) than the infants whose mothers were more positive and less intrusive. Infant undernutrition status also negatively affected information processing ability, i.e., underweight infants demonstrated slower information processing ability compared to the

normal weight infants. Infant novelty preference (recognition memory) was also predicted by maternal nutritional status, indicating that the lower the mother's BMI, the poorer the infant recognition memory. In sum, since the current study is the first of its kind to investigate the mechanisms through which maternal depression is linked to infant development and conducted in a convenience sample, before generalization, the findings need to be validated in a larger sample.

CHAPTER VI

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APPENDICES

APPENDIX A

Edinburg Postnatal Depression Scale (EPDS)

As you are pregnant or have recently had a baby, we would like to know how you are feeling. Please **underline** the answer that comes closest to how you have felt **IN THE PAST 7 DAYS**, not just how you feel today.

Here is an example, already completed.

I have felt happy:

Yes, all the time

Yes, most of the time

No, not very often.

No, not at all

This would mean: "I have felt happy most of the time" during the past week. Please complete the other questions in the same way.

In the past 7 days:

1. I have been able to laugh and see the funny side of things

As much as I always could

Not quite so much now

.

Definitely not so much

Not at all

2. I have looked forward with enjoyment to things

As much as I ever did

Rather less than I used to

Definitely less than I used to

Hardly at all

3. I have blamed myself unnecessarily when things went wrong

Yes, most of the time

Yes, some of the time

Not very often

No, never

4. I have been anxious or worried for no good reason

No, not at all

Hardly ever

Yes, sometimes

Yes, very often

5. I have felt scared or panicky for no very good reason

Yes, quite a lot

Yes, sometimes

No, not much

No, not at all

6. Things have been getting on top of me

Yes, most of the time I haven't been able to cope at all

Yes, sometimes I haven't been coping as well as usual

No, most of the time I have coped quite well

No, I have been coping as well as ever

7. I have been so unhappy that I have had difficulty sleeping

Yes, most of the time

Yes, sometimes

Not very often

No, not at all

8. I have felt sad or miserable

Yes, most of the time

Yes, quite often

Not very often

No, not at all

9. I have been so unhappy that I have been crying

Yes, most of the time

Yes, quite often

Only occasionally

No, never

10. The thought of harming myself has occurred to me

Yes, quite often

Sometimes

Hardly ever Never

APPENDIX B

Life Events (Life stress) Questionnaire

Please read each of the statements and encircle "**Yes"** if the event has occurred to you in the last two years, or "**No"** if the event has not occurred to you.

1. Death of a spouse	Yes	No
2. Divorce	Yes	No
3. Marital separation	Yes	No
4. Imprisonment	Yes	No
5. Death of a close family member	Yes	No
6. Personal injury or illness	Yes	No
7. Marriage (remarriage)	Yes	No
8. Marital reconciliation	Yes	No
9. Illness of family member	Yes	No
10. Rape	Yes	No
11. Gain a new family member	Yes	No
12. Business failure (loss)	Yes	No
13. Failure in financial state	Yes	No
14. Conflict with friends (neighbor)	Yes	No
15. Abduction of family member	Yes	No
16. Major loan (credit)	Yes	No
17. Change in family responsibilities	Yes	No

18. Trouble with in-laws	Yes	No
19. Spouse stops work (unemployment)	Yes	No
20. Increasing children's school fees	Yes	No
21. Change in living conditions	Yes	No
22. Revision of personal habits	Yes	No
23. Poor housing condition	Yes	No
24. Shortage of money for family needs	Yes	No
25. Change in church activities	Yes	No
26. Change in social relations and activities	Yes	No
27. Parenthood burden	Yes	No
28. Burden of family reunions, rituals	Yes	No
29. Food insecurity	Yes	No
30. Shortage of money for Vacation	Yes	No
31. Shortage of money during Christmas	Yes	No

APPENDIX C

Household Food Insecurity Access Scale

1. In the past year, how often did you worry that your household would not have enough food? Every day Most days Some days Only a few days Never
2. In the past year, how often were you or your child not able to eat the kinds of foods you preferred because of a lack of resources? Every day Most days Some days Only a few days Never
3. In the past year, how often did you or your child or eat just a few kinds of food day after day because of a lack of resources? Every day Most days Some days Only a few days Never
4. In the past year, how often did you or your child or eat food that you did not want to eat because of a lack of resources to obtain other types of food?
   Every day Most days Some days Only a few days Never
5. In the past year, how often did you or any household member eat a smaller meal than you felt you needed because there was not enough food? Every day Most days Some days Only a few days Never
6. In the past year, how often did you or any other household member eat fewer meals in a day because there was not enough food? Every day Most days Some days Only a few days Never
7. In the past year, how often was there no food at all in your household because there were no resources to get more? Every day Most days Some days Only a few days Never

8. In the past year, did you or any household member go to sleep at night hungry because there was not enough food? Every day Most days Some days Only a few daysNever

9. In the past year, did you or any household member go a whole day without eating anything because there was not enough food? Every day Most days Some days Only a few days Never

. **APPENDIX D**

SOCIAL SUPPORT SCALES

Social support measure (Sherbourne & Stwart, 1991)

1. About how many close friends and close relatives do you have (people you feel at ease with and can talk to about what is on your mind)? _____ (Write in numbers)

People sometimes look to others for companionship, assistance, or other types of support. How often is each of the following kinds of support available to YOU if you need it? (Please indicate the level of support you receive from others by placing a √ **mark** in one box for each question).

Social support indicators (questions)	None of the time (0)	A little of the time (1)	Some of the time (2)	Most of the time (3)	All of the time (4)
2.omeone to help you if you were confined to **bed**					
3. Someone you can count ***on*** to listen to you when you need to talk					
4. Someone to give you good advice about a crisis					
5. Someone to show you love and affection					
6. Someone to take you to the doctor if you needed it.					
7. Some one who hugs you					
8. Someone to have a good time with					

9. Someone to give you information to help you understand a situation.

10. Someone to confide in or talk to about yourself or your problems

11. Someone to get together with for relaxation.

12. Someone to prepare your meals if you were unable to do it yourself

13. Someone whose advice you really want

13. Someone to do things with to help you get your mind off things

14. Someone to help with daily chores if you were sick

16. Someone to share your most private worries and fears with

17. Someone to turn to for suggestions about how to deal with a personal problem

18. Someone to do something enjoyable with

19. Someone who understands your problems

20. Someone to love and make you feel wanted

Multidimensional Scale of Perceived Social Support (Zimet, Dahlem, Zimet & Farley, 1988)

Social support indicators (questions)	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1. There is a special person who is around when I am in need.					
2. There is a special person with whom I can share my joys and sorrows.					
3. My family really tries to help me.					
4. I get the emotional help and support I need from my family					
5. I have a special person who is a real source of comfort to me.					
6. My friends really try to help me.					
7. I can count on my friends when things go wrong.					
8. I can talk about my problems with my family.					
9. I have friends with whom I can share my joys and sorrows.					
10. There is a special person in my life who cares about my feelings.					
11. My family is willing to help me make					

decisions.

12. I can talk about my problems with my friends.

APPENDIX E

Socio-demographic information

Interview Center_____

Name of the mother_____

Name of the infant_____

ID number_____

Date_____

Please read each of the questions /statements listed below, and fill the blank space next to each

statement.

1. Research site

Regional state: SNNPR Zone: Wolayita County (Kebele):_____

2. Time the interview began _____ Time the interview ended_____

3. Mother's age _____

4. Infant's age _____months Infant's birth date ____ m ____d ___y

5. Infant's sex _____

6. Total household family size _____ Number of children below age 5 years _____

7. Mother' education _____ Father's education _____

For the following questions, please chooses the appropriate answer and encircle the numbers corresponding to your choice.

8. Marital status of the mother a) married b) never married c) divorced d) separated e) widowed

9. Do you own land? 1) Yes 2) No. If your answer is "Yes", approximately how many hectares is your land size? _____

10. Do you have livestock? 1) Yes 2) No. If your answer is "Yes", please specify the kind and number of your livestock. Cow____ Ox ____ Sheep _____ Goat ____ Donkey ____ Horse _____Poultry ____

11. What is the roof of your house made of? 1) Grass or straw 2) Corrugated iron sheet

12. How many rooms are in your house? _____

13. How many children do you have?_____

14. What is the birth order of this infant? 1) First 2) Second 3) Third 4) Fourth 5) Fifth 6) Sixth 7) Seventh 8) _____(please specify number if greater than 7^{th})

15. How many more children do you hope to have?_____

16. Do you hope to have no more babies after this baby? _____

17. Do your mother /grandmother or your spouse's 'mother/grandmother live with you in the same house? 1) Yes 2) No

If your answer for is "Yes", please specify the relatives who live with you?_____

_____

18. Do you think that living with your mother /grandmother or your spouse's mother/grandmother in the same house or in a close distance is good or bad? _____ Why? _____

19. What is your religion? 1) Orthodox 2) Islam 3) Protestant 4) other _____

20. How many hours do you spend at your religion centers for worshiping? Please write number of hours you spent in a week_____

21. How far the health centers are located from your house? 1) Very near 2) at a medium distance 3) far away. Please write approximate distance_____

22. How many times did your infant (this infant) get sick from malaria? _____

23. How many times did your infant get sick from diarrhea? _____

24. Do you have private latrine? 1. Yes, I have 2. No I use public latrine 3. No, I use open space.

25. Do you have access to tape water or do you use river?

1) I use public protected springs/wells 2) I use rivers 3) I use private wells

26. Please indicate whether you own the following items by placing **a √ mark** in the box.

Do you have the following items?

Items	Yes	No
1. Radio/tape-recorded		
2. Umbrella		
3. Shoes		
4. Bed		
5. Watch		

6. Gold

7. Private Latrine

8. animals to plough the land

9. Torch

APPENDIX F

Play materials used for mother-infant interaction Episodes

Episode	Materials
Episode 1	no material (the mother played in a cultural ways
Episode 2	a cup and four small balls
Episode 3	car
Episode 4	2 dolls with strings
Episode 5	a basket of play materials (a cup, four small balls, a car and two dolls with strings)

APPENDIX G

The MacArthur Scale of Subjective Social Status

Direction:

Think of this ladder representing places where people stand in Wolayita community. At the top of the ladder are the people who are the best off, those who have the most money, largest size of cattle and land, and most accepted by others in the community. At the bottom are those people who are the worst off, those who have the least money, least size of cattle and land, and least accepted by others. Here is the ladder, please show me your place in the Wolayita community by putting a √ **mark** on one of the 10 rungs of the ladder.

APPENDIX H

Mother-Infant Interaction Coding Manual (MICM)

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Table of Content

Acronyms

Acronyms	Behavioral Description
	Mother
(BF)	Breastfeeding
(CL)	Clapping
(CU)	Cuddling
(HU)	Hugging
(LA)	Laughing
(KS)	Kissing
(PU)	Picking up
(PH)	Pointing and Handing Toys and/or Objects
(RBF)	Rocking Back and Forth
(RP)	Repositioning Baby
(SM)	Smiling
(SN)	Snapping
(TO)	***Affectionate*** Touching **and** Patting
(VO)	Vocalization
	Child
(AA)	Arching away
(BA)	Banging objects
(CL)	Climbing Up
(EE)	Exploring environment
(GR)	Grasping
(KC)	Kicking

(PP)	Pushing and Pulling Objects
(PH)	Pointing and Handing Toys and/or Objects
(RE)	Reaching
(SU)	Sucking objects

Introduction

Purpose: The main purpose of this manual is to define a list of maternal and infant behaviors that are usually observed during the dyads play interactions.

Procedure and Coding Sheets. The mother- infant interaction was videotaped while the dyads were interacting in the following episodes (1) Free play (play without toys, by singing, talking, or peak-a-boo game), (2) Play by using toys (a cup and four small balls), (3) Play by using car (4) Play by using two dolls with strings (5) Play by using a basket of play materials (cup, four small balls, car, dolls). Please code the behaviors strictly following the definitions given in this manual.

Each of the behaviors listed below must be rated in a three, four or five point scale from never happened to most of the time or always happened, or the frequency of occurrence is counted as described in the manual.

Mother Categories

Appropriate maternal responsiveness to infant cry

Maternal responsiveness is when the mother responds ***appropriately*** to the infant's cry.

Activities: (a) picking up; (b) breast-feeding; (c) hugging; (d) rocking back and forth, (e) repositioning baby; (f) touching, patting baby; or (g) pointing to and handing toys and/or objects.

PLEASE RECORD INFANT DURATION OF CRIES

0 = Mother **does not** respond to the infant's cry at all.

1 = Mother **rarely** responds to the infant's cry. She does respond by doing **one** (1) of the above activities (a-g).

2 = Mother **sometimes** responds to the infant's cry. She does **two (2) of the activities (a-g).**

3 = Mother **most of the time** responds to infant's cry by doing **three (3)** activities. She understands the signal of her infant's cry and responds appropriately.

4 = Mother **most of the time** responds promptly and appropriately to infant's cry by using **three (3)** or more the activities listed above. In addition the **mother sings and/ or *coos*** (an utterance without words – mostly vowel sounds like "*oooooooo*" or "*ahhhhhh*" or "*eeeeee*" or "*mmmmmm*"). Singing may or may not include words.

XX = Infant **never** cries.

Decision Rule(s):

- If the infant does not cry, yet the mother demonstrates one or more of the activities listed above (a-g), then you will not code for 'Appropriate maternal responsiveness to infant cry' but 'Maternal warmth and sensitivity.'
- If the infant does not cry, yet he/or she is reaching, gesturing, touching, climbing up, kicking, arching back and/or bending, then you will not code for 'Appropriate maternal responsiveness to infant cry' but 'Maternal responsiveness to infant physical signals' and 'Maternal Warmth and Sensitivity.'

Examples

Maternal responsiveness to infant cry

Infant (:30-50): (cries)

Mother (:31): (picks up/ pats the infant)

Infant (:51): (cries stop)

Mother (:51): (breastfed infant)

(Score = 3/TO/ PI/BF)

(Also code for 7M WA/SE and 17I DISTRE)

Infant: (does not cry)

Mother: (hugs and coos)

(Score = XX)

(Instead code for 7M WA/SE)

Intervals (20 seconds)	**1M** CRY (0-4)		**1M** CRY (0-4)	
	I (Sec.)	M.	I (Sec.)	M
:00-:20	**XX**	**-**	**XX**	**-**

:21-:40	**:10**	**PU/ TO**	**XX**	**-**
:41-:60	**:10**	**BF**	**XX**	**-**
Total:	**:20**	**3**	**XX**	**-**

Note that ALL scores should also be coded in 'Maternal warmth and sensitivity.'

Appropriate maternal responsiveness to infant vocalization other than cry

Maternal responsiveness is when the mother responds ***appropriately*** to **infant vocalization other than cry.**

Activities: (a) picking up; (b) breast-feeding; (c) hugging; (d) rocking back and forth, (e) repositioning baby; (f) touching, patting or tickling baby; or (g) pointing to and handing toys and/or objects.

0 = Mother **does not** respond to the infant's vocalization **at all**.

1 = Mother **rarely** responds to her infant's vocalization. She does respond by doing **one (1)** activity (a-g).

2 = Mother **sometimes** responds to her infant's vocalization by doing **two (2)** activities.

3 = Mother responds to the infant's vocalization by **imitating** (with no words) in addition to her behavioral responses.

4 = Mother responds to the infant's vocalization by **SPEAKING with WORDS or singing**.

XX = Infant **never** vocalizes.

Decision Rule(s):

- If the infant does not vocalize other than cry, yet the mother demonstrates one or more of the activities listed above (a-g), then you will not code for 'Appropriate maternal responsiveness to infant vocalization other than cry' but 'Maternal warmth and sensitivity.'

- If the infant vocalizes other than cry, yet the mother responds with one or more of the activities listed above (a-g) within the ***next*** 20-second interval, then the appropriate code would be 0. But then again, the activity should be coded under 'Maternal warmth and sensitivity'.**'**

Examples

Maternal responsiveness to infant vocalization other than cry

Infant (:08-:10): (vocalizes)

Mother (:09): (imitates the infant like "*oooooo*"

Mother (:10): (pats)

Mother (:20): (kisses)

(Score = 3/ VO/ TO)

(Also code for WA/SE and 20I VOCAL)

Infant (:30-32): (vocalizes – "*babababa*")

Mother : (no response)

Mother (:41): (tickling, patting, touching) (Code for WA/SE)

(Score = 0)

(Also code for 20I VOCAL)

Intervals (20 seconds)	**2M** VOCAL (0-4)		**2M** VOCAL (0-4)	
	#	**M**	**#**	**M**
	Voc.		**Voc.**	
:00-:20	**:02**	**VO/ TO/ KS**	**XX**	**-**
:21-:40	**XX**	**-**	**:03**	**0**

:41-:60	**XX**	**-**	**XX**	**-**
Total:	**:02**	**3**	**:04**	**0**

Note that ALL scores should also be coded in ‘Maternal warmth and sensitivity’

Appropriate maternal responsiveness to infant physical signals

Infant physical signs include reaching, gesturing, touching, climbing up, kicking, arching back and/or bending. **Maternal responsiveness to infant's physical signals** should include (a) picking up; (b) breast-feeding; (c) hugging; (d) rocking back and forth, (e) repositioning baby; (f) touching, patting baby; or (g) pointing to and handing toys and/or objects.

0 = Mother **does not** respond to any of the infant's physical signals **at all**.

1 = Mother **rarely** responds to any of the infant's physical signals. She responds by doing **one** (1) activity from the activities listed above (a-g).

2 = Mother **sometimes** responds to any of the infant's physical signals. She does **two (2)** activities from the list (a-c) or **does one activity two times**.

3 = Mother **most of the time** responds promptly and appropriately to infant's physical signals (touch or climbing up). She **responds 3 or more times** and shows that she understands her infant's physical signals, and responds appropriately by doing activities listed above (a-g).

XX = Infant **never** makes any physical signal (touching or climbing up) to get maternal attention.

Decision Rule(s)

- If the infant does not cry, yet the mother demonstrates one or more of the activities listed above (a-g), then you will not code for 'Appropriate maternal responsiveness to infant cry' but Maternal warmth and sensitivity.'

Examples

Appropriate maternal responsiveness to infant physical signals

Infant (:19): (climbs up to the mother)

Mother (:20) (picks up the infant)

(**Score = 1/ PU**)

(Also code for 7M WA/SE)

Infant (:21): (touches the mother)

Mother (:22-60): (picks up and breastfeeds the infant)

(Score = 2/ PU/BF)

(Also code for 7M WA/SE)

Intervals (20 seconds)	3M PHYSIG (0-3)		3M PHYSIG (0-3)	
	I	**M**	**I**	**M**
:00-:20	**CL**	**PU**	**XX**	**-**
:21-:40	**XX**	**-**	**TO**	**PU/ BF**
:41-:60	**XX**	**-**	**XX**	**-**
Total:		**1**		**2**

Note that ALL scores should also be coded in 'Maternal warmth and sensitivity.'

Maternal responsiveness to infant eye contact

Note: Please code eye contact only initiated by the infant, not by the mother.

0 = Mother **does not** make eye contact with her infant **at all.**

1 = Mother only makes **one (1)** eye contact with her infant during the 60-second session.

2 = Mother makes **two (2)** eye contacts with her infant during each 60-second sessions.

3 = Mother makes **three (3)** eye contact with her infant during the 60-second sessions..

4 = Mother makes **four or more (4 >)** eye contacts with her infant during the 60-second session.

XX = Infant **never** initiates eye contact.

Examples

Maternal responsiveness to infant eye contact

Infant (:05): (looks at the mother)

Mother (:06): (continues to look at the interviewer)

(Score = 0)

Infant: (looks at the mother)

Mother: (continues to look away)

Infant: (looks away)

Infant: (looks at the mother)

Mother: (looks at the infant)

Infant/ Mother: (looks away)

Infant: (looks at the mother)

Mother: (looks at the infant) **(Score = 2)**

Intervals (20 seconds)	**4M** E-CON (0-3)		**4M** E-CON (0-3)	
	I	**M**	**I**	**M**
:00-:20	**I**	**0**	**I**	**0**
:21-:40	**XX**	**-**	**I**	**I**
:41-:60	**XX**	**-**	**I**	**I**
Total:		**1**		**2**

Note that the initiator of eye contact is circled.

Maternal intrusiveness

Intrusiveness is when the mother interrupts her infant from the given activity (playing) she/he is engaged in.

0 = Mother **never** intrudes at all. She accepts and acknowledges the infant's abilities and autonomy. She helps the infant to achieve his/her needs and realize his/her potential rather than preventing and controlling him/her from being involved in different activities. For example, when the infant tries to reach toys or objects far away from him/her, the mother assists the infant by pushing the objects near to him/her. When the infant plays with toys and manipulates objects, the mother watches the infant's steps with appreciation of his/her abilities, and gives autonomy to her infant to exercise his/her potential

1 = Mother engaged in **one (1)** instance of intrusive behavior in 60-seconds. **Rarely** the mother will interrupt the infant's playing by turning his/her head away from the object/ toys. The mother may also distract the infant by picking up and shaking the toys/objects, or by saying, "Look at me."

2 = Mother engages in **two (2)** instances of intrusive behavior in 60-second. In this case, the mother is **sometimes** intrusive and may control the infant's activities as she wishes, with no consideration of the infant's needs and abilities. The mother physically prevents the infant from doing what she/he wants to do. When the infant wants to reach and play with object, the mother occasionally interrupts the infant's actions by pulling him/her back, turning the infant's head to another direction, or the mother distracts the infant's attention by saying, "look at me", or by taking away the

object in which the infant is interested and by handing another object, the object of her (mother's) own interest. Note: If the mother engages in three or more of these activities, the code should be 3 (extremely intrusive) not 2 (very intrusive).

3 = Mother engages in **3 or more** instances of intrusive behavior in 60-second. Mother is **<u>extremely</u>** intrusive. She **always or almost always** controls the infant's actions or interferes while the infant is engaged in play. In addition, she is abrupt or impatient during much of the interaction session.

Decision Rule(s):

- If the infant's attention is outside of the stimuli (i.e.,toys or objects) and if the mother snaps her fingers or claps her hands to regain the infant's attention back on that stimuli, then you will not code for 'Maternal intrusiveness' but 'Maternal behavioral attention focus.'

Exception(s):

- If the mother takes the block(s) out of the infant's mouth, then this is not intrusive behavior and should not be coded. However, the sucking of the object should be coded as 'Infant Activity Level'

- In the case of Episode 1, 2 or 4, if the mother and infant are engaging in free-play, care giving or comfort-taking activities and the infant starts to explore his/her environment, then you will not code for 'Maternal intrusiveness' but 'Maternal behavioral attention focus'

Examples

Maternal intrusiveness

Interval I

Infant (:10-:15): (actively engaged in playing with one block)

Mother (:12): (interrupts by taking away the block with which the baby is playing and then giving the baby two other blocks)

(Score = 1)

Infant (:10-:15): (actively engaged in playing with one block)

Mother (:12): (interrupts by snapping her fingers)

Infant (:16-20): (continues to be engaged in playing with on block)

Mother (:18): (now begins to clap her hands)

Mother (:21): "Look at me"

(Code for 14M NEG-COM)

Mother (:22): (repositions her infant's body abruptly)

(Score = 3)

Intervals (20 seconds)	**5M** INTRU (0-3)	**5M** INTRU (0-3)
:00-:20	**PH**	**SN/CL**
:21-:40	**-**	**VO/ RP**
:41-:60	**-**	**-**

Total:	**1**	**4**

Maternal positive affect

Positive affect is when the mother ***smiles***, ***laughs*** or shows any sign of ***positive*** facial expression during the 60-second interaction session with the infant.

Please **count** the number of times the mother laughs or smiles during the 60-second session.

Examples

Maternal positive affect

Infant (:00-:10): (plays with object)

Mother (:08): (smiles)

Infant (:22): (coos)

Mother (:23): (laughs)

(Score = 2)

Mother (:02): (tickles the infants)

Infant (:03): (laughs)

Mother (:04): (laughs)

Infant (:10): (smiles)

Mother (:11): (smiles)

Mother (:30): (smiles) **(Score = 3)**

Intervals (20 seconds)	**6M** POSAFF (frequency)	**6M** POSAFF (frequency)
:00-:20	**SM**	**LA/ SM**
:21-:40	**LA**	**SM**
:41-:60	**-**	**-**
Total:	**2**	**3**

Maternal warmth and sensitivity

Maternal warmth and sensitivity is when the mother responds to infant *cues* (i.e., crying, vocalization, cooing, and other behavioral signs). Physical affection is showing affection by (a) picking up; (b) breast-feeding; (c) hugging; (d) rocking back and forth, (e) repositioning baby; (f) touching, patting baby; or (g) pointing to and handing toys and/or objects.

0 = Mother **never shows any** affection and sensitivity to infant's cues at all. She does not read the infant's needs and interests, and does not understand what the infant needs. She is preoccupied with her own thoughts and displays withdrawal behavior during the interaction session.

1 = Mother **rarely** shows affection and sensitivity to infant's cues; she does this only **once (1)**.

2 = She shows affection and sensitivity to infant's cues by doing **two to three (2-3)** activities. Mother is **sometimes** sensitive to infants cues and sometimes not. During the interaction session, mother sometimes reads the infant's needs and interests and understands what her infant wants; she sometimes accepts the infant's needs and shows physical affection.

3 = She shows affection and sensitivity by doing **four to five (4-5)** activities. Mother is **most of the time** sensitive and affectionate during the interaction session. She most of the time reads the infant's needs and interests, and frequently engaged in touching, hugging, kissing and smiling.

4 = She always reads the infant's needs and interests, and is engaged in **6 or more** activities. Mother is **most of the time** sensitive and affectionate throughout the

interaction session. In addition, she expresses **affection verbally** (e.g. by imitating infant's vocalizations, using positive tone of voice) during the interaction session.

XX = Infant **never** shows cues.

Examples

Maternal warmth and sensitivity

Infant (:10): (cries)

Mother (:11): (hugs) **(Score =1/ HU)**

(Also code for 1M CRY and 18I DISTRE)

Infant (:01): (touches the mother)

Mother(:02): (picks up the infant)

Mother (:03): (cuddles the infant)

Mother (:06): (rocks infant back and forth)

(Also code for 3M PHYSIG)

Infant (:21): (vocalizes)

Mother (:22): (kisses the infant)

(Score = 3/ CU/RBF/ KI)

(Also code for 2M VOCAL)

Intervals (20 seconds)	**7M** WA/SE (0-4)	**7M** WA/SE (0-4)
:00-:20	**HU**	**PU/ CU/RBF**
:21-:40	**-**	**KS**
:41-:60	**-**	**-**
Total:	**1**	**4**

Note: Please make sure that scores are consistent with 'Maternal responsiveness to cry,' 'Maternal responsiveness to vocalizations other than cry,' and 'Maternal responsiveness to physical signs.'

Maternal behavioral attention focus

Mother's physical behaviors of attracting infant's attention **to toys or objects** are coded as the following:

0 = Mother uses **no** behavior to get the infant's attention to focus on objects and toys.

1 = Mother uses **one** of the following behavioral means of attracting attention: a) repositioning b) shaking and banging the toys and/or objects c) turning the infant's head gently and playfully to the direction of the toys.

2 = Mother uses **two or three (2-3)** of the following behavioral means of attracting attention: a) repositioning b) shaking and banging the toys and/or objects c) turning the infant's head gently and playfully to the direction of the toys.

3 = Mother uses **four or five (4-5)** of the following behavioral means of attracting attention: a) repositioning b) shaking and banging the toys and/or objects c) turning the infant's head gently and playfully to the direction of the toys.

4 = Mother uses **six or more (**of the following behavioral means of attracting attention: a) repositioning b) shaking and banging the toys and/or objects c) turning the infant's head gently and playfully to the direction of the toys.

Exception(s):

- In the case of Episode 1, 2 or 4, if the mother and infant are engaging in free-play, care giving or comfort-taking activities and the infant starts to explore his/her environment, then you will not code for 'Maternal intrusiveness' but for 'Maternal behavioral attention focus'

Examples

Maternal behavioral attention focus

Infant (:15): (looking away from the toy)

Mother (:17): (claps her hands to get the infant's attention back to the toy)

Infant (:18): (turns turns to the toy)

Infant (:22): (looking away from the toy)

Mother (:23): (claps her hands to get the infant's attention back to the toy)

Infant (:25): (turns turns at the toy)

(Score: 2/ CL)

Infant (:05): (looking at two boys in his/her hands)

Mother (:07): (points and hands the infant the third block)

(Score: 1/ PH)

Intervals (20 seconds)	**9M** BEHA (0-3)	**9M** BEHA (0-3)
:00-:20	**CL**	**PH**

:21-:40	**CL**	
:41-:60		
Total:	**2**	**1**

Maternal verbal attention focus

Note: This section is not coded for episode 1, 2 and 4, because in these episodes toys/objects are not provided to the infant for play.

Maternal verbal ways of attracting infant's attention to focus on objects, toys, plays or activities are coded as a simple count. Please **count** the frequency of the following verbal attention focus used by the mother: a) calling infant's name and pointing to the toy/object b) saying "this is it", "take it", "it is a toy," "look at a toy", "it is a baby," "look at a baby", "look at this", or " what is this?" If the mother uses a question to focus the infant's attention please count the question under "questions" also.

Labeling

Mother's labeling is coded by looking at the occurrence of the following activities: Mother says to the baby the name of the object (e.g. "Spoon" "String" and "Blocks" or asks the object that names essential characteristic such as, "Is it soft?" or "Is it loud?") or function ("Can you play with it?" or "get your leg relaxed" – because the mother names the child's leg). For each coding session, please **count** the number of times the mother labels an object (use the transcript).

Verbal encouragement

The presence of maternal verbal encouragement in each 60-second session is counted by carefully listening to the words that mother uses to encourage the infant verbally, by saying "Yes, you did it", "Good Job" etc, words of encouragement. For each coding

session, please **count** the number of times the mother encourages her infant. (See transcripts).

Maternal command – imperatives that are not intended to focus infant's attention

Maternal verbal commands are coded by **counting** words of command from the transcript. For example, the mother says, "Turn here", "Do it", "Get up", "Don't do it", "Don't", "Leave it" etc.

Mother's questions

Maternal questions are coded by **counting** the number of questions from the transcript. For example, the mother says, "What is this?"

Mother's negative comment

Mother's negative comments are coded by **counting** the numbers of questions from the transcript. For example, the mother says, "Why do you prefer only one thing?"

Mother's calling the baby by using beloved names

Mother 's calling her baby by using culturally beloved infant names ("Tuna, "Mamush," etc.) is coded by **counting** how many times the mother called her baby with beloved name during the interaction session.

Maternal singing

Maternal singing is coded by **listening to the songs** in the tape and checking it with the transcript (In the transcript, the songs are translated as, for example, gospel songs, cultural songs etc.). Please **count** the number of times mother sings during the interaction session.

0 = Mother never sings

1 = Mother sings rarely – only 1 time

2 = Mother sings sometimes during the interaction session – 2 times during the 60-second session.

3 = Mother sings most of the time during the interaction session - 3 times during the 60-second session.

4 = Mother sings always during the interaction session – 4 or more times during the 60-second session, or almost never stops singing throughout session.

Infant Categories

Infant unhappy face

Infant unhappy face is outward expression of sadness or distress **without crying**.

0 = Infant **never** shows unhappy face

1 = Infant **rarely** shows unhappy face (only **once** during the 60-second session)

2 = Infant **frequently** shows unhappy face (**2 to 3 times** during the 60-second session)

3 = Infant **almost always** shows unhappy face (**more than 3 times** during the 60-second session)

Infant distress (crying)

Infant distress is a sign of negative emotion such as distress, frustration or unpleasant feelings **with crying.**

0 = Infant shows **no** sign of negative emotion at all.

1 = Infant **sometimes** displays distress or negative feelings during the interaction session, avoids plays, but sometimes also shows positive feelings and actively engages in the play. For example, the infant sometimes cries and is distressed but sometimes smiles and plays with the toys. Please code **one (1)** if the infant shows one of the following behaviors: cries once or avoids the object once and then starts playing with toys/objects, or explores the environment.

2 = Infant is **very** distressed; frequently avoids plays and resists maternal help. For example when the mother shows him/her toys and/or objects he/she pushes the objects away; frequently displays feelings of frustration, distress, or avoidance. Please code 2 if the infant cries or avoids toys/objects **two to three (2-3) times** in the interaction session.

3 = Infant is **extremely** distressed; **always** avoids play and resists maternal help. For example when the mother shows him/her toys and/or objects he/she pushes the objects away; displays feelings of frustration, distress, or avoidance throughout the interaction session. Please code 3 if the infant shows **4 or more times** symptoms of distress listed above during the interaction session.

Infant activity level

Infant activity is measured by the level at which the infant is engaged with the toys, objects or plays with the mother. Examples: a) explores the environment, b) reaching for the object, c) touches, d) pushes or pulls the objects, f) sucks the objects, and g) bangs the toys objects.

0 = Infant **extremely** fussy and/ or inactive.

1 = Infant **fussy and/ or seldom displays interest** (only **once** during the 60-second session)

2 = Infant **somewhat** active (**2 times** during the 60-second session)

3 = Infant **most of the time** is active and attentive (**3 or more times** during the 60-second session).

Decision Rule(s):

- If the infant is banging the object anytime during Episodes 3, 5.1, 5.2, 5.3, and 5.4, and if the mother takes the object away from the infant, then you should also code for 'Maternal intrusiveness.'

Example

Infant activity level

Infant (:15): (bangs with the object)

Mother (:18): (takes the object away from infant)

(Also code for INTRU)

Infant (:22): (puts the toy in his mouth)

(Score = 2): (takes the object out of the infant's mouth)

(Score: 2/ BA/SU)

Infant (:01): (reaches for the toy)

Infant (:25): (sucks on the toys)

Infant (:30) : (pushes the toy)

Infant (:41): (bangs with the object)

(Score = 3/ RE/SU/PP/BA)

Intervals (20 seconds)	**19I** ACTIV (0-3)	**19I** ACTIV (0-3)
:00-:20	**BA**	**RE**
:21-:40	**SU**	**SU/PP**
:41-:60		**BA**
Total:	**2**	**3**

Infant vocalization level

Infant vocalization is measured by the level at which the infant made any vocal expressions **other than crying.**

Please **count** the number of times the infant made any vocal expression other than cry (i.e., laugher, coos, etc.) during the 60-second session.

Example

Infant vocalization level

Infant (:15): (vocalizes)

Mother (:16): (repositions the infant)

Infant (:21): (vocalizes)

Mother (:22): (imitates the infant)

Infant (:41): (vocalizes)

Mother (:42): (laughs)

(Also code for 2M VOCAL)

Intervals (20 seconds)	**20I** VOCAL (frequency)
:00-:20	**1**
:21-:40	**1**
:41-:60	**1**
Total:	**3**

Mother-infant interaction coding sheet

		Mother									Infant			
		Appropriate Responsiveness				Non Appropriate	Sensitivity		Attention Focus		17I UNHAP (0-3)	18I DISTR (0-3)	19I ACTIV (0-3)	20I VOCAL (frequency)
	Interval (20-sec.)	1M CRY (0-4)		2M VOCAL (0-4)		4M INTRU (0-3)	5M POS (frequency)	6M WA/SE (0-4)[1]	8M VERB (frequency)	9M BEHA (0-4)				
		I Cry (Sec.)	M	I vocal #	M									
Episode 1 Free play #_____	:00-:20													
	:21-:40													
	:41-:60													
	Total:													
Episode 2. Play with toys (balls & cup) #_____	:00-:20													
	:21-:40													
	:41-:60													
	Total:													
Episode 3 Play with toys (car) #_____	:00-:20													
	:21-:40													
	:41-:60													
	Total:													
Episode 4 Play with toys (doll) #_____	:00-:20													
	:21-:40													
	:41-:60													
	Total:													
	:21-:40													
	:41-:60													
	Total:													

Infant ID No_____ Coder's Name_____

Maternal vocalizations

		Vocal Response						
	Interval (20-sec.)	**10M LABEL (frequency)**	**11M VERB-ENC (frequency)**	**12M COM (frequency)**	**13M QUES (frequency)**	**14M NEG-COM (frequency)**	**15M BELNA (frequency)**	**16M SI (frequency)**
Episode 1 Free play #_____	:00-:20							
	:21-:40							
	:41-:60							
	Total:							
Episode 2. Play with toys (balls & cup) #_____	:00-:20							
	:21-:40							
	:41-:60							
	Total:							
Episode 3 Play with toys (car) #_____	:00-:20							
	:21-:40							
	:41-:60							
	Total:							
Episode 4 Play with toys (doll) #_____	:00-:20							
	:21-:40							
	:41-:60							
	Total:							
Episode 5 Play with toys (balls & cup, car, doll) #_____	:00-:20							
	:21-:40							
	:41-:60							
	Total:							

Infant ID No_____Coder's name_____

Table1

Sample Demographics (Phase I)

Variable	Mean(SD)	Median	N (%)	Range	
				Minimum	Maximum
Maternal Age (years)	27.4 (3.73)	27.5	192	20	40
Infant Age (months) Below 11Months 11 -12 Months 13-17 Months	11.6 (1.44)	12.0	193 45 (23.3) 120(62.2) 28(14.5)	8	17
Infant Sex Male Female			193 94 (48.7) 99 (51.3)		
Maternal Education Level Not Read and write Grade 2-6 Grade 7-10			68 (35.2) 110 (57) 15 (7.8)		
Marital status Married Divorced Widowed	 186 2 3		 186 (97.4) 2 (1) 3 (1.6)		
Livestock ownership No Animal One Animal Two Animals Three or More Animals			 62 (33) 94(50) 22 (11.7) 10 (5.3)		
Land ownership Households had No Land Households Owned land			 29 (15.2) 162 (84.8)		
Household Material Asset One or No asset Two Assets Three Assets Four Assets Five Assets Six and more (6-9)			 59 (30.9) 49 (25.7) 39 (20.4) 16 (8.4) 11(5.8) 17(8.9)	1	9

Table 1 Sample Demographics (continued)

Variable	Mean(SD)	Median	N (%)	Range	
				Minimum	Maximum
Subjective SES category				1	7
1			80 (42.1)		
2			63 (33.2)		
3			21 (11.1)		
4			13 (6.8)		
5			5 (2.6)		
6			5 (2.6)		
7			3 (1.6)		
Family size	5.7 (1.83)	6	193 (100)		
Roof of House Type					
Grass/Thatcher			104 (55)		
Corrugated iron sheet			85 (45)		
House Rooms (number)					
Only one room			97 (50.5)		
Two Rooms			37 (19.3)		
Three Rooms			53 (27.6)		
Four Rooms			5 (2.6)		
Water unprotected sources/rivers			142 (73.6)		
Use Public Protected Springs and Wells			51 (26.4)		

Table 2
Predictor and moderator Variables (Phase I)

Variable	Mean(SD)	Median	N (%)	Range	
				Minimum	Maximum
EPDS	10.067 (2.721)	10.000	193 (100)	1	18
Life Stress	13.52 (4.555)	14.00	178	0	25
Food Insecurity	18.111(5.272)	18.000	189	0	28
Social support$_{20}$	26.314 (10.162)	26.000	188	0	76
Social Support$_{12}$	18.941(6.61)	19.00	188	2	48
BMI	20.197 (1.854)	20.133	193 (100)	15.082	25.436

Note: EPDS (Edinburg Postpartum Depression Scale), Social Support$_{20}$ (Social Support Scale with 20 items), Social Support$_{12}$ (Social Support Scale with 12 items), BMI (Body Mass Index).

Table 3

Outcome Variables (Phase I)

Variable	Mean(SD)	Median	N (%)	Range	
				Minimum	Maximum
Infant WLZ	-.145 (1.384)	-.140	193 (100)	-.466	4.940
Infant WAZ	-.599 (1.486)	-.580	193(100)	-5.000	4.000
Infant LAZ	-.736 (2.498)	-.880	193 (100)	-7.050	5.160

Note: WLZ (Weight-for- Length Z-score), WAZ (Weight-for-Age Z-score) LAZ (Length-for-Age Z-score)

Table 4
Correlations of Maternal Psychosocial and Demographic Variables to Infant Age, Sex and Growth Outcomes, Weight-for-Length, Weight-for-Age and Length-for-Age (Phase 1)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.EPDS	1														
2.Life Stress	**.189***	1													
3. Food Insecurity	**.266****	.003	1												
4. Social $Supp_{20}$	-.121	**-.214****	-.057	1											
5. Social $Supp_{12}$	**-.209****	-.113	**-.205****	**.523****	1										
6. Mother's BMI	-.041	-.051	.018	.069	-.067	1									
7. Mother's Age	-.007	**.260****	-.058	-.081	-.093	**.222****	1								
8. Infant Age	-.061	.073	**-.154***	.026	**.160***	-.019	.077	1							
9. Infant Sex	-.055	-.125	.028	-.083	-.069	-.001	.039	-.028	1						
10. Mother's Edu	-.185*	-.118	-.024	.085	**.285****	-.112	**-.367****	.012	-.079	1					
11. SES Ladder	**-.275****	.020	**-.374****	-.084	**.219****	**-.172***	-.079	.123	-.010	**.161***	1				
12. Asset	**-.281****	-.052	**-.210****	-.037	**.257****	**-.169***	**-.166***	.101	-.097	**.302****	**.658****	1			
13. Livestock	-.111	-.138	-.099	.045	.123	.007	-.059	.034	**-.166***	**.176***	**.385****	**.367****	1		
14. WHZ	-.061	.054	**-.204****	-.010	.007	**-.145***	-.080	**-.161***	-.058	.086	.107	.132	.093	1	
15. WAZ	-.065	-.005	-.114	.102	.117	.007	-.117	.042	-.112	**.208****	.123	**.179***	.129	**.506****	1
16. HAZ	-.002	-.059	.030	**.145***	**.134**	.116	-.084	.139	-.107	**.179***	.036	.092	.086	**-.151***	.763**

Note: * $p < .05$, ** $p < .01$

EPDS (Edinburg Postpartum Depression Scale), Social $Supp_{20}$ (Social Support scale with 20 items), Social $Supp_{12}$ (Social Support scale with 12 items), BMI (Body Mass Index), Mother's Edu (Mother's education),WLZ (Weight-for- Length Z-score), WAZ (Weight-for-Age Z-score) LAZ (Length-for-Age Z-score)

Table 5
Regression Output of Maternal and Infant Variables Predicting Infant Weight-for-Length (Phase I)

Predictors	B	SE B	t	p
Food Insecurity	-.057	.019	-2.965	**.003**
Maternal BMI	-.494	.256	-1.927	**.055**
Infant Age	-.195	.068	-2.853	**.005**
Household Asset	.063	.055	1.139	.256

Note: R^2=.107, F (4, 182), p<.001

Table 6
Regression Output of Maternal and Infant Variables Predicting Infant Weight-for-Age (Phase I)

Predictors	B	SE B	t	p
Maternal Education	.103	.045	2.305	**.022**
Subjective SES	.023	.109	.210	.834
Household Asset	.063	.083	.760	.448
Livestock	.122	.146	.837	.404

Note: R^2=.062, F(4, 179), p<.05

Table 7
Regression Output of Maternal and Infant Variables Predicting Infant Length-for-Age (Phase I)

Predictors	B	SE B	t	p
Social Support 20	.018	.021	.850	.397
Social Support 12	.021	.033	.616	.539
Infant Age	.220	.124	1.784	.076
Maternal Education	.166	.076	2.182	**.030**

Note: R^2=.065, F(4, 178), p<.05

Table 8

Sample Demographics (Phase II)

Variable	Mean(SD)	Median	N (%)	Range	
				Minimum	Maximum
Maternal Age (years)	26.81(3.9)	26	73(100)	20	38
Infant Age (months) Below 11Months 11 -12 Months 13-17 Months	11.79(1.52)	12	73(100) 14(19.2) 48(65.7) 11(15.1)	8	17
Infant Sex Male Female			32 (43.8) 41(56.2)		
Maternal Education Level Not Read and write Grade 2-6 Grade 7-10			 28(38.4) 39(53.4) 6 (8.2)		
Marital status Married Divorced Widowed			 71 (98.6) 1 (1.4) -		
Livestock ownership No Animal One Animal Two Animals Three or More Animals			 23 (32.4) 38 (46.5) 3 (11.3) 7 (9.9)		
Land ownership Households had No Land Households Owned land			 10 (13.7) 63 (86.3)		
Household Material Asset One or No asset Two Assets Three Assets Four Assets Five Assets Six and more (6-9)			 23 (31.5) 16 (21.9) 15 (20.5) 5 (6.8) 6 (8.2 8 (10.9)		

Table 8 Sample Demographics/Phase II (continued)

Variable	Mean(SD)	Median	N (%)	Range	
				Minimum	Maximum
Subjective SES category 1 2 3 4 5 6 7			 31 (43.7) 18 (25.4) 8 (11.3) 5 (7) 2(2.8) 5 (7) 2 (2.8)	1	7
Family size	5.59 (1.53)	6			
Roof of House Type Grass/Thatcher Corrugated iron sheet			 41 (56.2) 32 (43.8)		
House Rooms (number) Only one room Two Rooms Three Rooms Four Rooms			 42 (57.5) 9 (12.3) 21 (28.8) 1 (1.4)		
Water Source Use unprotected sources/ rivers Use Public Protected Springs and Wells			 56 (76.7) 17 (23.3)		

Table 9
Descriptive Statistics of Predictor and moderator Variables (Phase II)

Variable	Mean(SD)	Median	N (%)	Range	
				Minimum	Maximum
Maternal Intrusiveness	.29 (.66)	0	69	0	3
Maternal Positive Affect	1.46	1.14(1.4)	69	0	4.4
Maternal Warmth and Sensitivity	1.80	1.67	69	0	4
Maternal attention focus	3.02	3.00	69	0	4
Infant unhappy face	.20	.00	69	2.4	2.4
Infant Distress	.20	.00	69	0	1.4

Infant Activity level	2.1	2.20		0	3
Infant Vocalizations	1.0	.40	69	0	8.8
Maternal BMI	20.05	20.18		15.96	24.16
EPDS total					
EPDS Group Low High			73 (100) 33 (45.2) 40 (54.8)		
Infant Physical Growth Groups Normal WLZ Wasted (WLZ ≤-2.0) Normal WAZ Underweight WAZ ≤-2.0) Normal LAZ Stunted (LAZ ≤-2.0)			 68 (93.2) 5 (6.8) 61 (83.6) 12 (16.4) 47 (64.4) 26 (35.6)		

Note: EPDS (Edinburg Postpartum Depression Scale), Note: WLZ (Weight-for- Length Z-score), WAZ (Weight-for-Age Z-score) LAZ (Length-for-Age Z-score), BMI (Body Mass Index).

Table 10

Descriptive Statistics of Outcome Variables (Phase II)

Variable	Mean(SD)	Median	N (%)	Range	
				Minimum	Maximum
Novelty preference Total	.47	.50	67	0	.87
novelty preference (< .05) novelty preference (≥ .05) Missing			34(46.6) 33(45.2) 6 (8.2)		
Longest Look duration (seconds)	13.15	10.61	73 (100)	4.02	36.0

Table 11 Correlations of Maternal and Infant Behaviors to Maternal Psychosocial Variables and Infant Longest Look and Novelty Preference (Recognition Memory).

	1	2	3.	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. EPDST8 total	1																	
2. epdstgroup4	.951**	1																
3. Intrusiveness	-.151	-.170	1															
4. Positive affect	-.197	-.249*	.088	1														
5. Warmth/sensitivity	-.007	-.090	.038	.150	1													
6. Behavioral att focus	-.073	-.075	-.188	.241*	.308**	1												
7. Infant vocalizations	-.122	-.142	.054	.121	.322**	.247*	1											
8. Infant unhappy face	.108	.068	-.165	-.119	.319**	.137	-.008	1										
9. Infant activity	-.086	-.039	-.048	.231	-.141	.260*	.230	-.236	1									
10. Infant distress	.029	.004	-.176	.002	.216	.130	.063	.806**	-.165	1								
11. WLZ	-.118	-.152	.115	.139	.269*	-.037	.215	.063	-.182	.183	1							
12. WAZ	.030	-.005	.016	.040	.311**	.041	.280*	.044	-.070	.134	.597**	1						
13. LAZ	.142	.127	-.073	-.079	.184	.092	.181	-.014	.062	-.003	-.062	.757**	1					
14. Wasted	.253*	.215	.001	-.026	-.154	-.149	-.121	-.059	-.047	-.071	-.594**	-.406**	-.050	1				
15. Underweight	.030	.063	-.046	-.026	-.244*	-.111	-.202	-.144	-.135	-.178	-.408**	-.650**	-.450**	.465**	1			
16. Stunted	.008	-.005	.163	.126	-.071	-.223	-.104	-.082	-.004	-.033	.186	-.504**	-.755**	.025	.365**	1		
17. Longest look	.221	.277*	-.094	-.246*	-.143	-.036	-.236	.065	.012	.100	-.112	-.005	.113	.002	.124	-.041	1	
18. Novelty pref total	.254*	.210	-.257*	.137	.170	.195	.100	-.022	.080	-.009	.149	.130	.041	-.212	-.271*	.109	-.063	1
19. Novelty prefgroups	.189	.141	-.097	.080	.060	.045	.020	-.208	.030	-.134	.113	.161	.109	.013	-.143	-.073	-.114	.696**

Table 12
One-Way ANOVA Comparing Mean differences of Duration of Longest Look between Underweight and Normal Weight Infants

	Sum of Squares	df	Mean Square	F	p
Between Groups	60.956	1	60.956	1.102	.297
Within Groups	3927.593	71	55.318		
Total	3988.549	72			

Table 13

One-Way ANOVA Comparing Mean differences of Novelty Preference between Underweight and Normal Weight Infants

	Sum of Squares	df	Mean Square	F	p
Between Groups	.208	1	.208	5.146	**.027***
Within Groups	2.622	65	.040		
Total	2.830	66			

Table 14

One-Way ANOVA Comparing Mean differences of Longest Look Duration between Stunted and Normal Length Infants

	Sum of Squares	df	Mean Square	F	p
Between Groups	6.775	1	6.775	.121	.729
Within Groups	3981.774	71	56.081		
Total	3988.549	72			

Table 15

One-Way Analysis of Variance (ANOVA) Comparing Mean Differences of Novelty Preference between Stunted and Normal Length Infants

	Sum of Squares	df	Mean Square	F	p
Between Groups	.033	1	.033	.775	.382
Within Groups	2.797	65	.043		
Total	2.830	66			

Table 16

Summary of a Two by Two Analysis of Variance (Two EPDS groups X Two Stunting Groups) Comparing Means Differences across the Groups

Source	Type III Sum of Squares	df	Mean Square	F	p
Stunted Groups	.062	1	.062	1.500	.225
EPDS Groups	.195	1	.195	4.722	.034
Stunted * EPDS Groups	.044	1	.044	1.066	.306
Error	2.595	63	.041		
Total	17.632	67			

Figure 1. Moderation by maternal low BMI (≤19) of the relation of maternal EPDS scores to infant weight-for-length (WAZ)

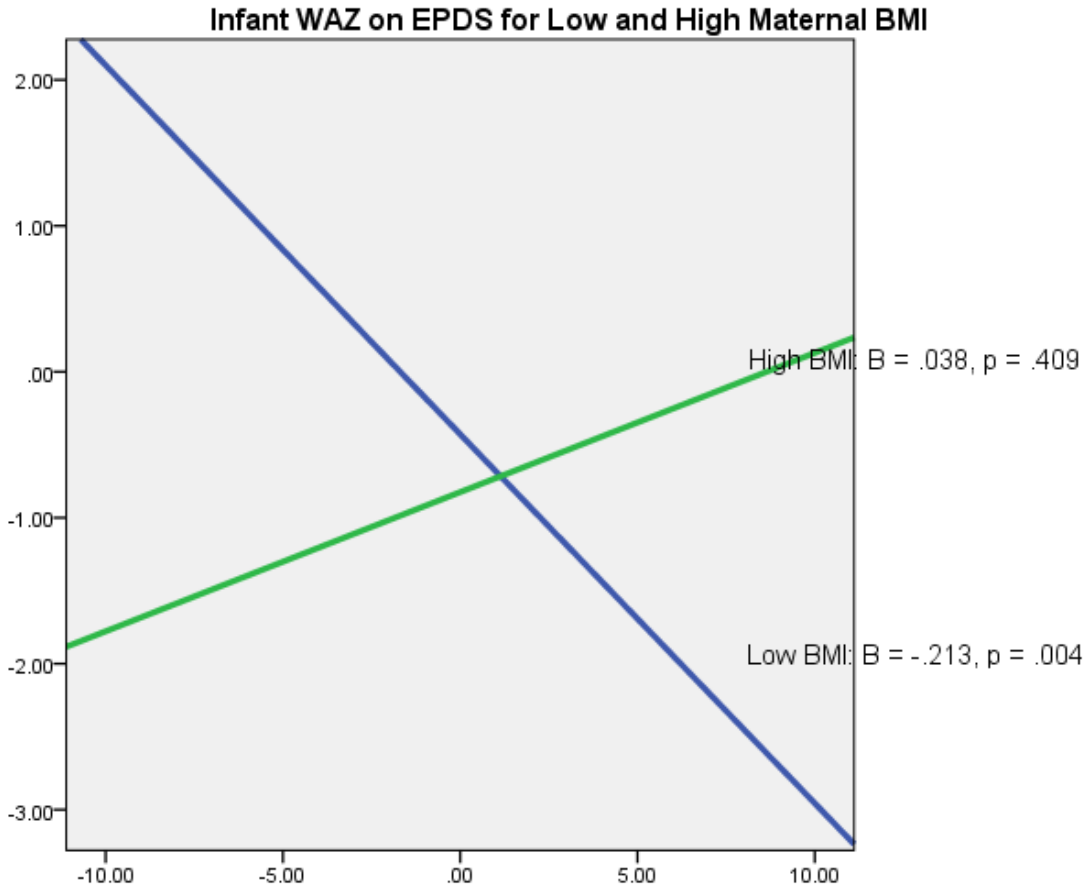


Figure 2. Moderation by maternal low BMI (≤19) of the relation of maternal EPDS scores to infant LAZ

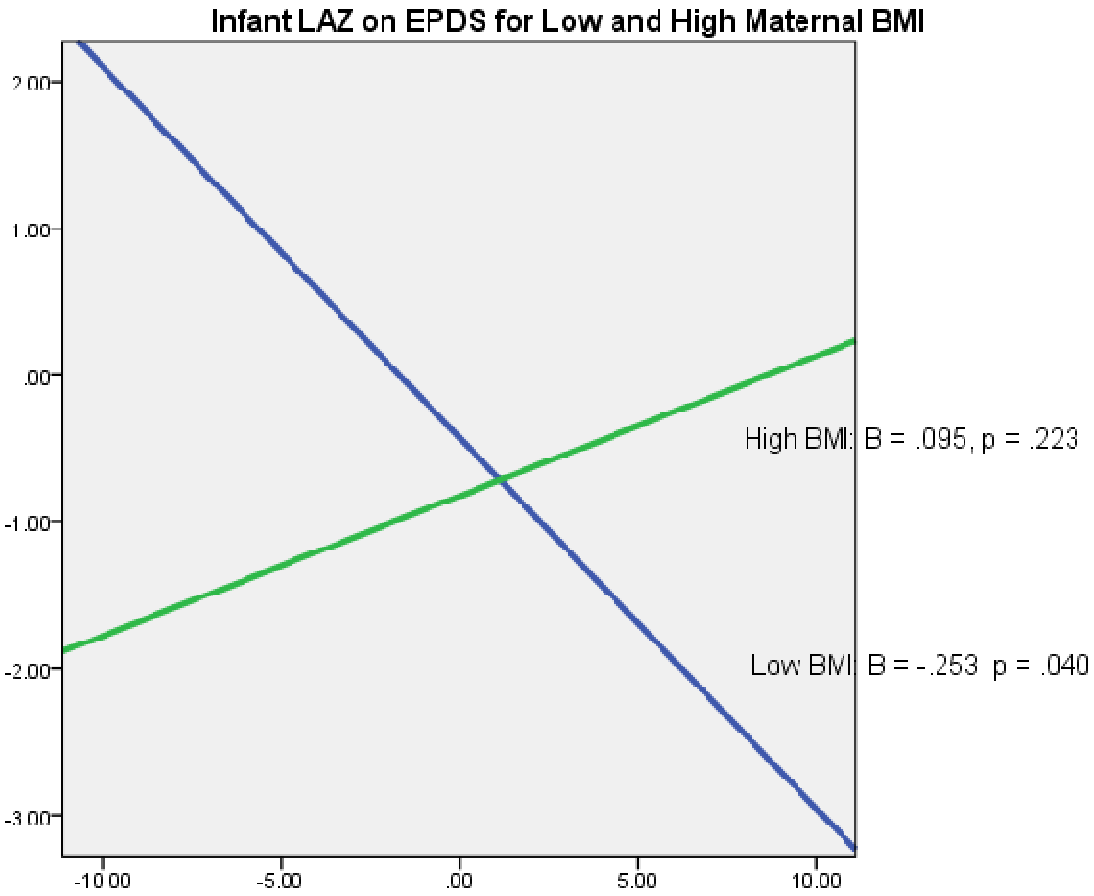


Figure 3. Moderation by maternal low BMI (BMI ≤18.5) of the relation of maternal EPDS scores to infant LAZ

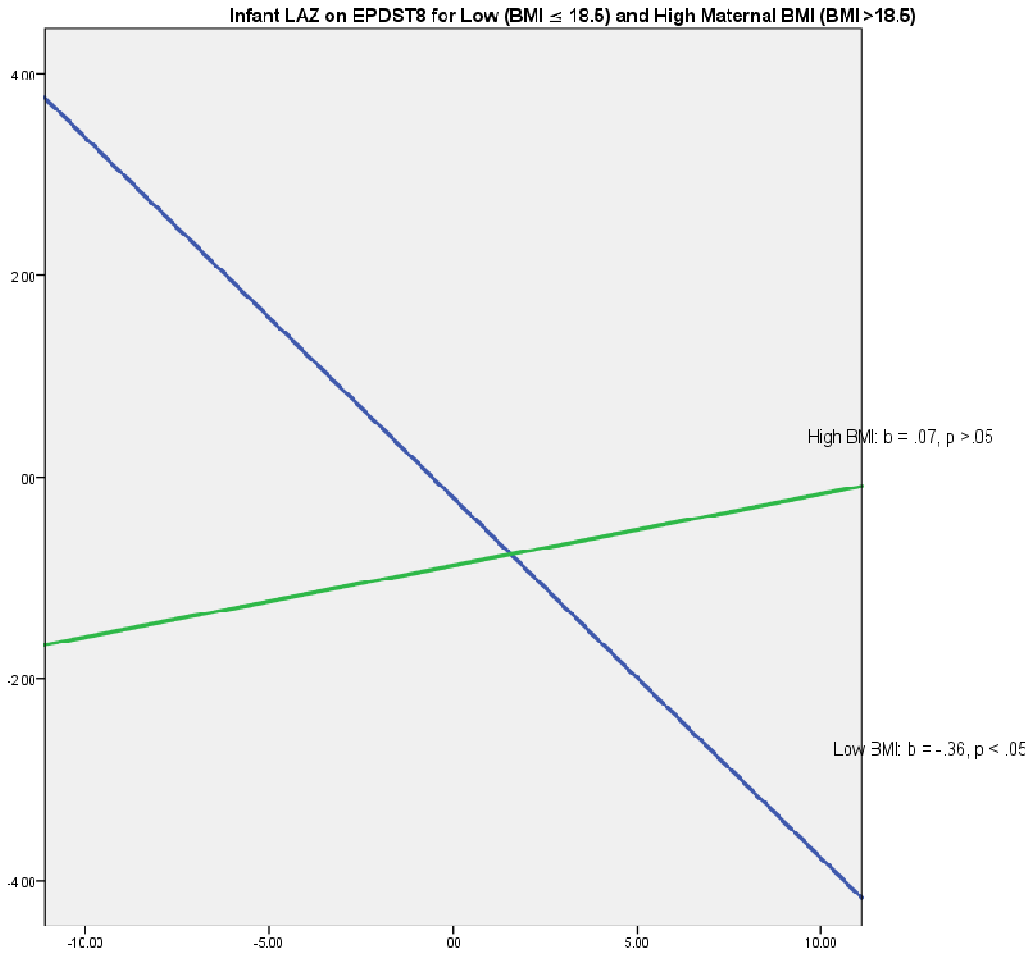


Figure 4. Moderation by maternal low BMI (BMI ≤18.5) of the relation of maternal EPDS scores to infant WAZ

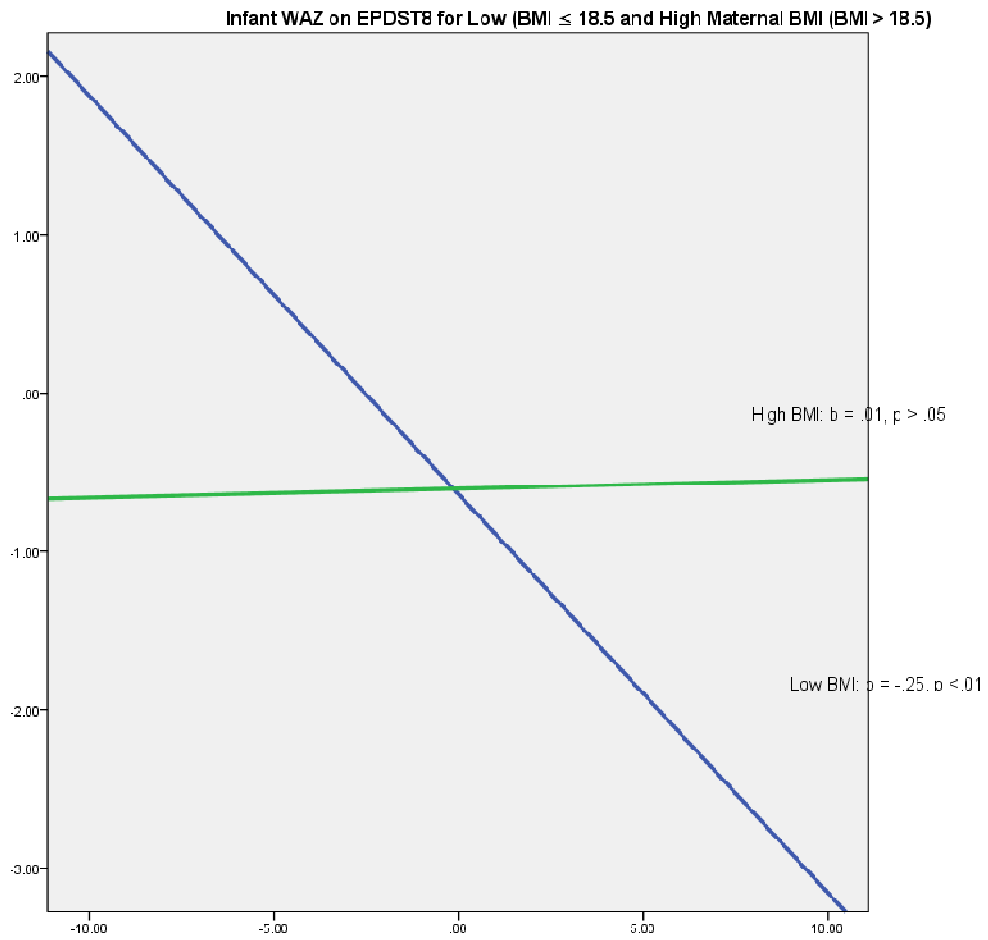


Figure 5. Moderation by Maternal Social Support of the relation of the Maternal EPDS Scores to Infant Weight-for-Length

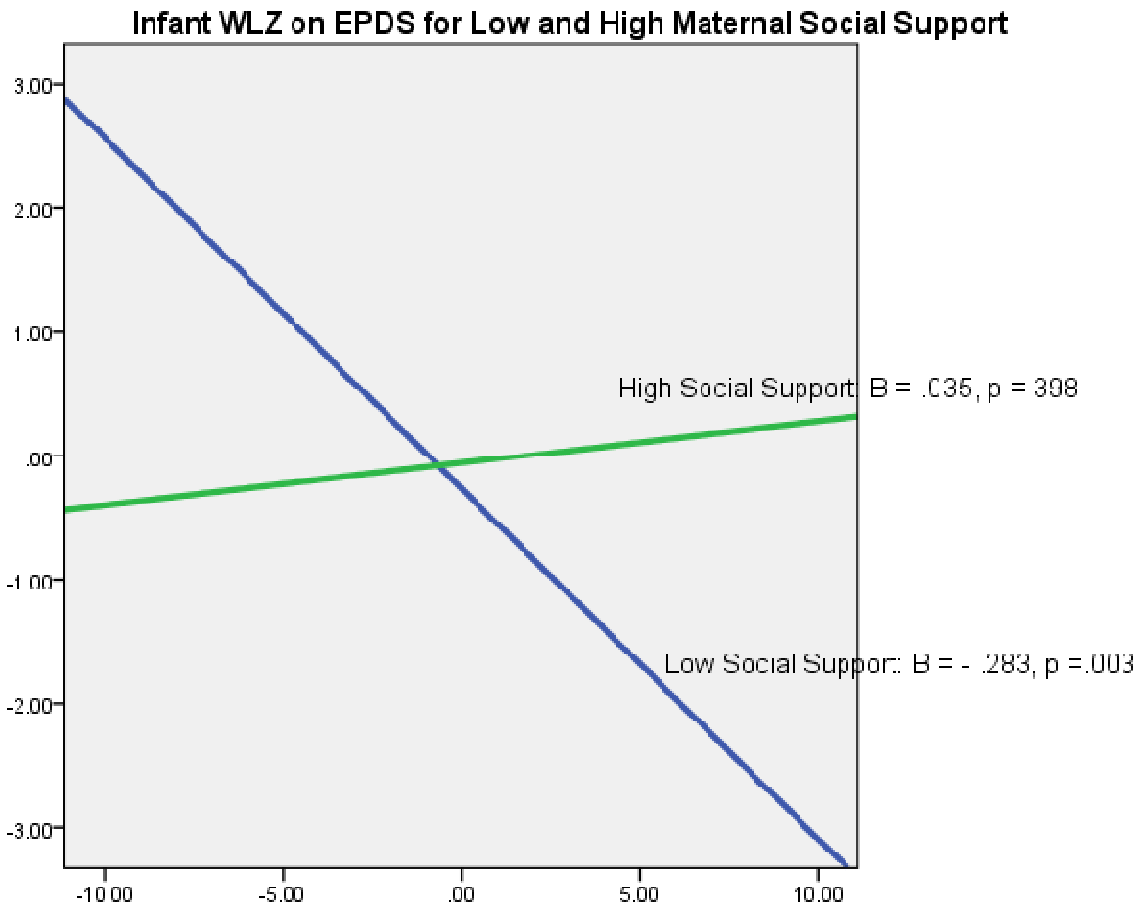


Figure 6. Moderation by Maternal Social Support of the relation of the Maternal EPDS Scores to Infant Weight-for-Age (WAZ).

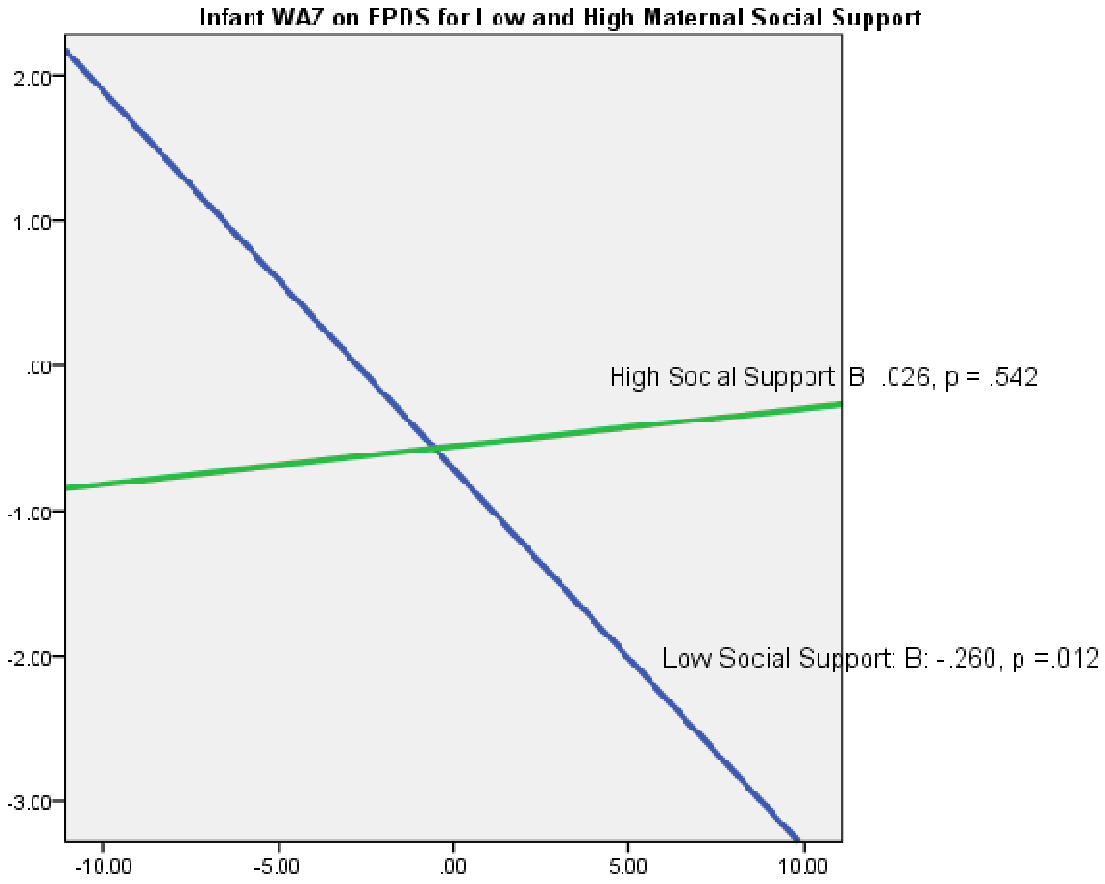
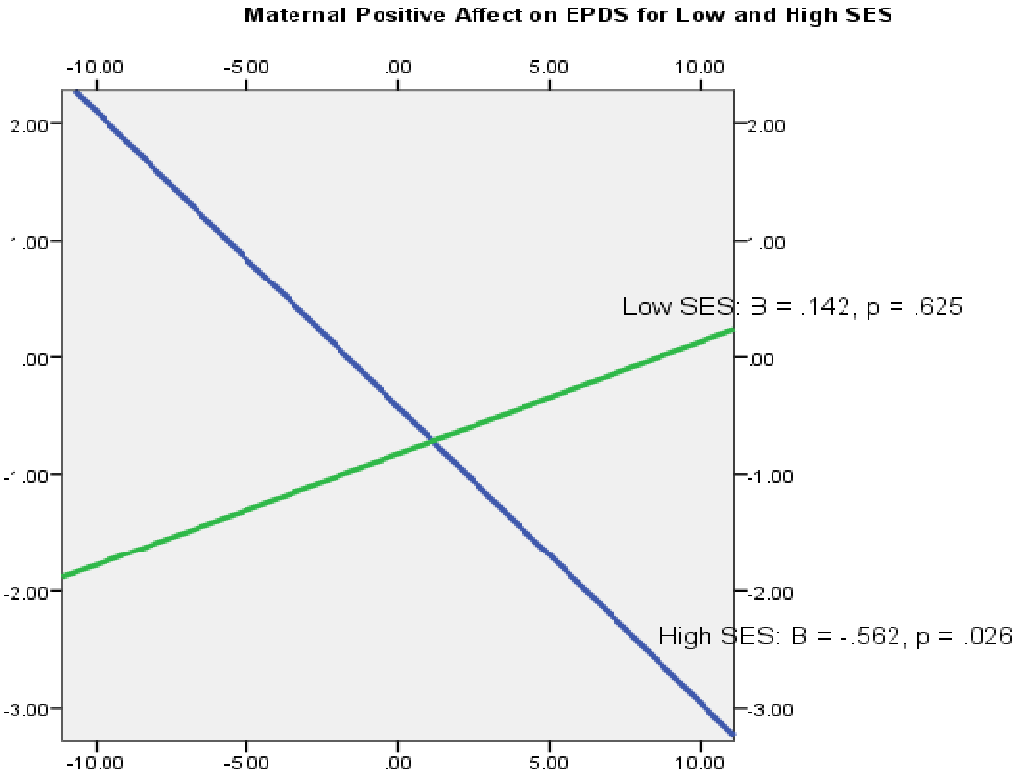


Figure 7. Moderation by Maternal SES of the Relation of Maternal Depression to Maternal Behaviors (Positive affect).



VITA

Tesfaye Woltamo Wogene

Candidate for the Degree of

Doctor of Philosophy

Thesis: INFANT RECOGNITION MEMORY AND PHYSICAL GROWTH IN WOLAYITA: RELATIONS TO MATERNAL DEPRESSION, FOOD INSECURITY, SOCIAL SUPPORT, AND MOTHER-INFANT INTERACTION

Major Field: Human Sciences

Biographical:

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Completed the requirements for the Doctor of PhilosophyHuman Sciences at Oklahoma State University, Stillwater, Oklahoma in December, 2012.

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Completed the requirements for the Bachelor of Arts in Education/Pedagogical Science at Addis Ababa University-, Addis Ababa, Ethiopia in 1986.

Experience:

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Faculty member of Nekemte Teachers' Training Institute, Oromya, Ethiopia, 1987-1999

Professional Memberships:

Member of South Western Psychological Association (SWPA), 2008 -present

Name: Tesfaye Woltamo Wogene Date of Degree: December, 2012

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: INFANT RECOGNITION MEMORY AND PHYSICAL GROWTH IN WOLAYITA: RELATIONS TO MATERNAL DEPRESSION, FOOD INSECURITY, SOCIAL SUPPORT, AND MOTHER-INFANT INTERACTION

Pages in Study: 194 Candidate for the Degree of Doctor of Philosophy-

Major Field: -Human Sciences

Scope and Method of Study: The purpose of the study was to assess relations of maternal depression (***Edinburgh Postnatal Depression Scale***, EPDS), food insecurity, social support, maternal nutrition status (BMI), maternal education, family economic resources, and perceived social status with mother-infant interaction and infant weight-for-age (WAZ), length-for-age (LAZ), weight-for-length (WLZ), and recognition memory. In phase I, mother-infant dyads (*N*=201) were recruited by convenience sampling in Wolayita, Southern Ethiopia. Maternal depression, stressful life events, food insecurity, social support, demographic variables, and maternal weight and height and infant weight and length were measured. In phase II, 83 mother-infant dyads were recruited from the phase I sample; attrition reduced the sample to 73 (*n*=34 with EPDS ≤12 and *n*=39 with EPDS ≥ 14). Mother-infant interaction was videotaped and infant cognitive skills, look duration (information processing speed) and recognition memory (novelty preference) were measured.

Findings and Conclusions: Main findings were (1) Continuous EPDS scores measuring maternal depression were not directly associated with infant growth. Food insecurity, β= -.215, p <.01, maternal low BMI, β= -.137, p <.05, and infant age, β= -.203, p<.01, predicted WLZ. Maternal education predicted WAZ, β= .176, p<.05, and LAZ, β=.131, p< .08. (2) Relation of maternal depression to infant growth was moderated by maternal BMI and social support. For infants of mothers with BMI > 18.5 or more social support or EPDS was not related to weight or length. For infants of mothers with BMI < 18.5, EPDS was significantly negatively related to WAZ and LAZ; for infants of mothers with low social support, EPDS was significantly negatively related to WAZ and WLZ. (3) EPDS scores categorized from low to high depressive symptoms were significantly negatively related to maternal positive affect in interactions. (4) Lower maternal depression and higher maternal positive affect were associated with faster infant information processing but infant underweight status was associated with poorer recognition memory. Results are interpreted as reconciling previous inconsistent findings.

ADVISER'S APPROVAL: Dr. Laura Hubbs-Tait

Oklahoma State University Institutional Review Board

Date:	Friday, September 09, 2011	Protocol Expires:	9/8/2012
IRB Application No:	HE1046		
Proposal Title:	Anthropometric and Cognitive Measures of Infants in Wolayita, Southern Ethiopia: Relation to Maternal Depression, Stress, Social Support and Mother-Infant Interaction		
Reviewed and Processed as:	**Modification/Continuation**		

Status Recommended by Reviewer(s) **Approved**

Principal Investigator(s) :

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Stillwater, OK 74078

Approvals are valid for one calendar year, after which time a request for continuation must be submitted. Any modifications to the research project approved by the IRB must be submitted for approval with the advisor's signature. The IRB office MUST be notified in writing when a project is complete. Approved projects are subject to monitoring by the IRB.

☒ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

Signature : Shelia M. Kennison

Shelia Kennison, Chair, Institutional Review Board

Friday, September 09, 2011
Date