A Randomised Controlled Trial Of
Psychosocial Intervention With Mothers Of
Undernourished Children Using
Primary Care Services In Jamaica

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Abstract

Background: Previous studies have shown that psychosocial stimulation can benefit the development of undernourished children. However, these studies have been highly controlled research studies. We know of no reports of the effectiveness of integrating stimulation into existing nutrition and health services for undernourished children. There is also little information about the psychosocial function of mothers of undernourished children or on the benefit derived by the mothers of undernourished children from a stimulation program.

Aims: The main aim of the research was to integrate psychosocial stimulation into existing nutrition and health services for undernourished children in Jamaica and to determine the effect of the intervention on the children’s growth and development and on the mother’s child-rearing knowledge and practices and frequency of depressive symptoms. At baseline, mothers of undernourished children were compared with mothers of adequately nourished children on maternal depression, parenting self-esteem, social support, exposure to stressors and stimulation provided in the home.

Methods: The study was a randomised controlled trial in which 18 government health centres in the parishes Kingston, St. Andrew and St.Catherine were randomly assigned to an intervention or control group. 139 undernourished children (WAZ ≤ -1.5z scores) aged 9 to 30 months were recruited into the study from the centres. At the beginning and end of the study all children had their development assessed on the Griffiths developmental scales, and their weight and length measured. Also the mothers' child-rearing knowledge, practices and frequency of depressive symptoms were assessed with a questionnaire and scores calculated. A case-control study was conducted at baseline and 71 adequately nourished children (WAZ > -1z scores) from the same health centres and matched for sex and age group with the undernourished children were enrolled into the study. Questionnaires were administered to the mothers of both groups of children to determine the levels of maternal depression, parenting self-esteem, social support and daily stressors and the stimulation provided in the home was assessed.
**Intervention:** Government health aides, already working in the centers, conducted weekly home visits for 1 year. During the visits, mothers were shown appropriate play activities to do with their young child using home made toys and books. Parenting issues were also discussed. Both groups received the standard nutrition and health care for undernourished children.

**Results of case-control study:** Mothers of undernourished children came from poorer homes but had similar social support to mothers of adequately nourished children. They were more depressed, had lower levels of parenting self-esteem (both $p < .01$), reported higher levels of economic stress ($p < .001$) and provided a less stimulating home environment ($p < .05$). However, after controlling for social background variables there was no independent relationship between either psychosocial function or home stimulation and nutritional status. Undernutrition was found to be mainly explained by economic factors.

**Results of randomised controlled trial:** The development levels (DQ) of children in both groups declined during the study. However, the intervened children declined significantly less - 7.91 points (95% confidence interval: 4.49, 11.33), than the controls. There was also a significant treatment effect on the hearing and speech subscale 10.66 (5.89, 15.44), the hand and eye subscale 6.82 (3.40, 10.24) and the performance subscale 11.10 (5.48, 16.72). There was no significant benefit of intervention on the motor subscale. Children in both groups improved modestly, though significantly in weight for age, height for age and weight for height but there was no benefit of intervention. Compared with the control group, the mothers in the intervention group improved significantly more in child rearing knowledge ($p < .001$) and child rearing practices ($p < .01$) and reduced their depressive symptoms ($p < .05$).

**Conclusions:** Mothers of undernourished children had poorer psychosocial function than mothers of adequately nourished children and hence health services for undernourished children should pay attention to the psychosocial status of the mother as well as the physical condition of the child. Integrating a program of parenting education and psychosocial stimulation into primary care services was both feasible and effective and improved undernourished children's development a substantial amount (0.94 of a standard deviation for DQ). Mother's parenting knowledge and practices and frequency of depressive symptoms also improved.
Acknowledgements

The research conducted for this thesis was achieved through the efforts and commitment of many people to whom I owe a debt of thanks.

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I also wish to express my sincere thanks to my husband, Paul for providing me with lots of support while I write this thesis and to my mother for her continuing support and encouragement.

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To my family:

Paul and Vincent Henningham
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<tr>
<td>BMI</td>
<td>Body mass index (weight (kg) / height (m) $^2$)</td>
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<td>CHA</td>
<td>Community health aide</td>
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<tr>
<td>CI</td>
<td>Confidence interval</td>
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<tr>
<td>ECCD</td>
<td>Early childhood care and development</td>
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<td>ECE</td>
<td>Early childhood education</td>
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<td>DQ</td>
<td>Developmental quotient</td>
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<tr>
<td>GNP</td>
<td>Gross national product</td>
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<td>HAZ</td>
<td>Height for age z score</td>
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<td>HOME</td>
<td>Home observation for measurement of the environment</td>
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<td>IBR</td>
<td>Infant behaviour record</td>
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<td>ICDS</td>
<td>Integrated child development service</td>
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<td>IHDP</td>
<td>Infant health and development program</td>
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<td>IQ</td>
<td>Intelligence quotient</td>
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<tr>
<td>MLWin</td>
<td>Multi-level modeling programme</td>
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<tr>
<td>MOH</td>
<td>Ministry of Health</td>
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<tr>
<td>NCHS</td>
<td>National Centre for Health Statistics</td>
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<tr>
<td>PCDC</td>
<td>Parent child development centre</td>
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<td>PIOJ</td>
<td>Planning Institute of Jamaica</td>
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<td>PPVT</td>
<td>Peabody Test</td>
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<tr>
<td>SD</td>
<td>Standard deviation</td>
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<tr>
<td>SE</td>
<td>Standard error</td>
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<tr>
<td>SES</td>
<td>Socio-economic status</td>
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<tr>
<td>SPSS</td>
<td>Statistical package for the social sciences</td>
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<tr>
<td>UNICEF</td>
<td>United Nations Children’s Fund</td>
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<td>WAZ</td>
<td>Weight for age z score</td>
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<tr>
<td>WHO</td>
<td>World Health Organisation</td>
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<td>WHZ</td>
<td>Weight for height z score</td>
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Background: Previous studies have shown that psychosocial stimulation can benefit the development of undernourished children. However, these studies have been highly controlled research studies. We know of no reports of the effectiveness of integrating stimulation into existing nutrition and health services for undernourished children. There is also little information about the psychosocial function of mothers of undernourished children or on the benefit derived by the mothers of undernourished children from a stimulation program.

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I would like to thank the research assistants who assisted with this project: Joan Thomas for measuring the children and administering the PPVT, Michael Ellis for recruiting the children, Pauline Alcott and Ava Mundell for testing the children and administering the final questionnaires and Margaret White for administering the baseline questionnaires to the mothers.

I am very grateful to the community health aides who conducted the home visits: Arethra Black, Margaret Heslop Clemmings, Jacqueline Eastman, Ivy Edwards, Cynthia Ferron, Jean Grant, Sharon Johnson, Yvonne Gordon Pinnock, Pauline Robertson, Sandra Vassel and Ingrid Whitney. Thanks also to all the public health nurses for
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Dedication

To my family:

Paul and Vincent Henningham
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<th>Description</th>
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<tr>
<td>BMI</td>
<td>Body mass index (weight (kg) / height (m)^2)</td>
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<td>CHA</td>
<td>Community health aide</td>
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<tr>
<td>CI</td>
<td>Confidence interval</td>
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<tr>
<td>ECCD</td>
<td>Early childhood care and development</td>
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<td>ECE</td>
<td>Early childhood education</td>
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<td>DQ</td>
<td>Developmental quotient</td>
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<tr>
<td>GNP</td>
<td>Gross national product</td>
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<td>HAZ</td>
<td>Height for age z score</td>
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<td>HOME</td>
<td>Home observation for measurement of the environment</td>
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<td>IBR</td>
<td>Infant behaviour record</td>
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<td>ICDS</td>
<td>Integrated child development service</td>
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<td>IHDP</td>
<td>Infant health and development program</td>
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<td>IQ</td>
<td>Intelligence quotient</td>
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<td>MLWin</td>
<td>Multi-level modeling programme</td>
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<td>MOH</td>
<td>Ministry of Health</td>
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<td>NCHS</td>
<td>National Centre for Health Statistics</td>
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<td>PCDC</td>
<td>Parent child development centre</td>
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<td>PIOJ</td>
<td>Planning Institute of Jamaica</td>
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<td>PPVT</td>
<td>Peabody Test</td>
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<td>SD</td>
<td>Standard deviation</td>
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<td>SES</td>
<td>Socio-economic status</td>
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<tr>
<td>SPSS</td>
<td>Statistical package for the social sciences</td>
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<td>UNICEF</td>
<td>United Nations Children’s Fund</td>
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<td>WAZ</td>
<td>Weight for age z score</td>
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<tr>
<td>WHO</td>
<td>World Health Organisation</td>
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<td>WHZ</td>
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Chapter 1: Literature Review

1.1. Introduction

This study comprises two components.
The first component concerned a comparison of mothers of undernourished children with mothers of adequately nourished children on some of the characteristics which influence the quality of parenting.
The second and major component examined the effect of adding a programme of early childhood stimulation to existing health and nutrition services for undernourished children, within a primary health care setting in Jamaica.

In addition, a large proportion of the children in this treatment trial (72%) also participated in a zinc supplementation study conducted by Dr. Meeks-Gardner. The zinc study is not a part of this thesis, but the possible effects of zinc were considered in the analysis of the results. No effects of zinc supplementation were found on child growth or development and hence the role of zinc in child development will only be briefly discussed in this section.

In this chapter the literature pertaining to the two components of the study will be reviewed. The chapter contains the following:

- A discussion of the nature of child development and the factors that impact on parenting quality
- A description of the context of undernutrition and a review of the literature on undernutrition and child development and behaviour
- A review of the effects of early childhood education on child development
- A description of the context of the study including information about the health and nutrition services in Jamaica, the family environment and child-rearing practices.
1.2. Child Development and Parenting

This section includes the following:

- An introduction to child development and the factors affecting child development
- A discussion of some important factors which influence parents and parenting including poverty, social support, depression, parenting self-esteem and chronic life stress.

1.2.1. Child Development

*Child development is multi-dimensional* and includes cognitive, motor, social and emotional domains, all of which are interdependent with changes in one domain affecting changes in the others.

*Children's development is also multi-determined* being influenced by a multitude of factors including genetics, child characteristics (e.g. temperament), the biological state of the child (e.g. health and nutritional status), the proximal environment (e.g. level of stimulation in the home, quality of maternal-child interaction) and the distal environment (e.g. culture, urban-rural residence, type of neighbourhood) (Wachs, 2000). Some factors are protective, whereas others make the child more vulnerable and their effects may be additive or interactive.

Due to the multi-determined nature of child development there are individual differences in reactivity to any specific risk factor as the response will depend on the presence of other risk and protective factors. For example, in Brazil, the development of children born small for gestational age was shown to be detrimentally affected by low levels of stimulation in the home, maternal illiteracy and frequent diarrhea whereas the development of normal birth weight children was not (Grantham-McGregor et al, 1998). In addition, good neonatal health was found to be a protective factor in predicting IQ for poor low birth weight children but not for low birth weight children from high SES families (Bradley et al, 1994). The multi-determined nature of child development leads to interventions not always having the predicted effect. For example, a study in Jamaica
showed that the effect of eating breakfast on child behaviour varied as a function of the quality of the schools. In well-organised schools, the children’s behaviour improved whereas in two overcrowded and more chaotic schools the children’s behaviour deteriorated after being given breakfast (Grantham-McGregor et al, 1998b). The biological status of the child therefore interacted with the quality of the school to produce differential effects.

*Child development is transactional* and in addition to the environment influencing the child, the child is also an active participant in shaping his or her own environment. An example of the transactional nature of child development comes from the literature on child temperament. Temperament ratings of children’s activity, distractibility and persistence were found to be associated with teacher attitudes and behaviour to individual children in school (Martin, 1989)

*Child development is also specific* and a particular influence or intervention may positively affect one area of development and yet have a neutral or deleterious effect on another. For example, a didactic preschool curriculum produced greater gains in IQ than two comparison curriculum models after two years of intervention and showed IQ gains over a no-preschool control group up to age 10 years (Schweinhart et al, 1986). However, the children experiencing the directive and highly structured preschool curriculum were found to engage in more delinquent acts and display more antisocial behaviours at age 15 than children who attended preschools using a more child-centred curriculum.

*Risk factors covary* and it is often difficult to isolate the effect a particular risk factor on child development. An example of the co-occurrence of risk is poverty which covaries with low maternal education, teenage parenting, minority ethnic status, undernutrition, low birth weight, low maternal IQ, high levels of maternal depression, unsafe neighbourhoods, household crowding and low levels of stimulation in the home to list just a few. Several studies have shown that it is the co-occurrence of a number of risk factors rather than the presence of any particular single risk factor which is important in
predicting child outcome. For example, Sameroff et al (1993) investigated the effect of ten family and environmental risk factors (that is, mother's mental health, anxiety, behaviour, developmental beliefs and educational attainment, family size and social support, major stressful life events, occupation of head of household and disadvantaged minority status) on child IQ at 4 and 13 years and found that after controlling for SES, ethnicity and maternal IQ multiple risk continued to predict child IQ at both ages accounting for between one third to one half of the variance in scores. Liaw & Brooks-Gunn (1994) also report a decrease in child IQ with an increase in the number of risk factors whereas child behaviour was not affected by a cumulative risk index.

*Risk and protective factors continue to affect development throughout childhood* and the long term effects depend on previous, current and future experiences. For example, the effect of social disadvantage on child school achievement and adult adjustment is cumulative (Schoon et al, 2002). Present adversity is only predictive of outcome at certain developmental periods. There may however be sensitive periods, for example, there is some evidence that the period from gestation to age 2 years is particularly vulnerable to the effects of undernutrition on cognition (Gorman, 1995).

Wachs (1999) provides three ways in which early experiences can affect later outcomes which illustrate how previous, present and future experiences affect outcomes.

*Sensitising:* early exposure to a risk factor can act to sensitise children to further risk factors in later childhood such that they are more vulnerable than children who did not experience a similar risk during infancy. An example of this is the effect of short term hunger on child cognition. In a ‘missing breakfast’ study in Jamaica, no effect of missing breakfast on child cognitive function was found for children who had no history of undernutrition (Simeon & Grantham-McGregor, 1989). However, stunted children and children who had suffered from severe malnutrition in early childhood were susceptible to the effects of missing breakfast.
**Blunting:** early exposure to a given risk factor can also impair the ability of children to benefit from later experiences. For example, in a study of Korean orphans, stunted children who were adopted into American families scored lower on IQ and school achievement tests than orphans who were not stunted on adoption (Winick et al, 1975). The duration of exposure to risk is also important as among the stunted children, those adopted before age 2 years scored higher than children adopted after age 2 (Lien et al, 1977).

**Steeling:** early exposure to protective factors may serve to protect the child from later risk factors. This is illustrated by studies on resilience which have investigated the factors which enable certain children to develop well and adapt successfully in the face of adversity. For example, Werner (2000) describes one of the most salient protective factors in the lives of high risk children in the longitudinal study of Kauai as the presence of a competent caregiver in the first year of life. In addition, early interventions for children at social, economic and nutritional disadvantage have demonstrated long term effects on children’s cognition, academic achievement and behaviour even though the children continue to be reared in disadvantaged homes (Walker et al, 2000; Schweinhart et al, 1993; Ramey & Ramey 1998).

It is important to note that even when children have been exposed to considerable deprivation in early childhood they can still benefit from provision of development enhancing environments in later life as shown by the study by Winick et al (1975) cited above. Another example of the reversibility of effects of exposure to risk in early childhood comes from Chile. Among children who had suffered severe malnutrition in the first year of life, those children that were adopted had higher IQ scores at age 6-12 years than children who either returned to their biological families or entered an institution (Colombo et al, 1992) (Figure 1.1.).
1.2.2. Parenting

The quality of parenting a child receives has been shown to be an important factor influencing that child’s development throughout childhood but especially in the early years before the school and peer group begin to exert their influence. Belsky (1984) states that:

*Across childhood, parenting that is sensitively attuned to children’s capabilities and to the developmental tasks they face promotes a variety of highly valued developmental outcomes, including emotional security, behavioural independence, social competence and intellectual achievement.*

pp: 85

Like child development, parenting is also multi-determined and is influenced by factors within the child, factors within the parent and with contextual sources of stress and support (Belsky 1984). Bronfenbrenner (1989) also describes parent-child relationships as being determined by the dyad’s interactions with the social and cultural environment. Hence a mother’s ability to parent will be affected by her child’s temperament, health
and nutritional status; by her own personality, ability, educational experience and psychosocial functioning, as well as by stressors in her environment and by the support she receives through her social network and community agencies. Some of the factors which affect parenting ability and child development are discussed in more detail below including poverty, maternal depression, parenting self-esteem, social support and chronic stressors.

**Poverty**

Children living in poverty have been shown to have average or above average development in the 1st year of life but a marked decline is evident in the 2nd year especially in the cognitive domain (Golden & Burns, 1976). Motor development is generally unaffected by poverty and in fact the motor development of poor boys has been found to be more advanced than that of their more affluent peers (Petterson & Albers, 2001).

Living in poverty has been shown to have a deleterious effect on other child developmental outcomes including physical health and nutritional status, school achievement and emotional and behavioural problems (Schoon et al, 2002; Jackson et al, 2000; Brody et al, 2002). However, as poverty covaries with a host of other risk factors it is difficult to disentangle the effects of poverty per se on the developmental trajectory of children.

Brooks-Gunn & Duncan (1997) reviewed evidence of the effects of the duration, timing and severity of poverty on children after controlling for confounding variables using national longitudinal data sets. Chronic poverty and severe poverty were found to exert the greatest effects on children’s development and child cognition and school achievement were affected more than social and emotional outcomes. In addition, the timing of poverty was important with poverty during the early years being more predictive of poor long-term outcomes than poverty during later childhood and adolescence.
The effect of poverty on children is mediated largely through its effect on parents and parenting. For example, the quality of the home environment accounts for up to half of the effect of poverty on child IQ (Duncan et al, 1994; Brooks Gunn et al, 1993). Poverty also leads to poor maternal mental health and poor parent-child interaction which have further negative effects on the child's development. Another important mediator of the effect of poverty on child development is through poor health and undernutrition (see section 1.3. for a review of undernutrition and child development and behaviour).

**Social Support**

Social support has been defined in a variety of ways. The size, density and proximity of the social network is one aspect of social support but the aspects of support which have been found to be most important in determining parenting quality are the actual help received (in terms of practical assistance, provision of information and emotional support) and the parents satisfaction with it.

High levels of social support are associated with better quality parenting in terms of improved parenting attitudes and more social-emotional and cognitive growth fostering behaviour (Crnic et al, 1983), provision of a more organized and stimulating environment (Hall et al, 1991; Burchinal et al, 1996), use of more praise and less control (Donahue-Jennings et al, 1991) and increased levels of maternal acceptance and involvement (Burchinal et al, 1996). Social support is particularly important in buffering the effects of stressors on parent mental health and parenting ability. A pervasive stressor in many disadvantaged families is poverty and poor families with higher levels of social support (defined as help received) demonstrate less punitive parenting behaviours than poor families receiving little help (Hashima & Amato, 1994). Another stressor for the maternal child relationship is a child with a difficult temperament and mothers with high levels of social support have been found to maintain higher levels of parenting self-efficacy and lower levels of depression when faced with an infant with a difficult temperament than mothers of 'difficult' infants with low levels of social support (Cutrona & Troutman, 1986). There was no effect of social support on the parenting self-efficacy and levels of depression of mothers of infants with easier temperaments.
Social support has also been linked to child cognition and behaviour. Crnic et al (1983) found that high levels of social support reported by the mother predicted responsiveness and positive affect in the infant while in another study the level of social support was a significant predictor of child IQ at age 4 years (Bee et al, 1982). Low levels of maternal social support have also been shown to be associated with high levels of resistance and avoidance in infants and an increase in the proportion of anxious attachments for irritable infants (Crockenberg, 1981). In one study pregnant women were randomly assigned to receive a one year home visiting social support intervention or a control group and there was a significant increase in the number of secure attachments at 14 months in the experimental group (Jacobson & Frye, 1991). The authors hypothesized that the effect was mediated through an increase in maternal sensitivity and warmth. Crnic et al (1983) from a longitudinal observational study also reported that the effects of social support on the child were largely mediated through the effect on maternal behaviour and the quality of parenting.

Maternal Depression
The prevalence of maternal depression has been documented for several countries. From national Maternal and Infant Health surveys in the US (Civic & Holt, 2000) and Canada (McLennan et al, 2001) a prevalence rate of between 24% and 28% 17 months after delivery and between 17% and 20% at 36 months was reported. In Costa Rica and Chile, between 35% to 50% of mothers of young children had experienced a major depressive episode in the past or had concurrent severe dysphoric mood (Wolf et al, 2002) while in a survey in a peri-urban community in South Africa, 34.7% of women suffered major depression in the post-partum period (Cooper et al, 1999). Maternal depression is thus a major public health issue in both developed and developing countries.

The determinants of maternal depression have been found to be an unwanted pregnancy and poor child health (McLennan et al, 2001), living in unsafe neighbourhoods (Hill & Herman-Stahl, 2002), low socio-economic status (Salt et al, 1988) especially poverty (Eamon & Zuehl, 2001; Petterson & Albers, 2001), poor maternal health (Galler et al,
and having low levels of social support, high levels of marital conflict and a number of children of preschool age (Sharp et al, 1995). Many of these characteristics are risk factors in the lives of children living in developing countries.

Maternal depression has been found to be associated with a poorer quality of parenting. A meta-analysis of 46 observational studies of the effect of depression on parenting found that maternal depression has a moderate association with negative or hostile parenting behaviours (for example, intrusiveness, negative affect, punitive discipline practices), a small to moderate association with disengaged behaviours (for example, neutral affect, non-involvement) and a small negative association with positive parenting behaviours (praising child, positive affect, sensitivity, showing affection) (Lovejoy et al, 2000). Even mild forms of depression including depressed affect can negatively affect the quality of maternal-child interactions. Maternal depression has also been shown to be associated with an early cessation of breastfeeding even after controlling for socio-economic status and the home environment (Galler et al, 1999).

Depression of the mother is a risk factor for child social and emotional problems from infancy to adolescence (Beck, 1999) with age-typical behaviour problems being associated with maternal depression (Teti & Gelfand, 1991). For example, infants of depressed mothers are less likely to be securely attached and more likely to have avoidant or disorganized attachments (Martins & Gaffan, 2000) while for preschool age children, maternal depression is associated with problem behaviours (Sommerfelt et al, 2001). Furthermore, the effects of depression on socio-emotional development are evident for children from families of both low and high socioeconomic status. Maternal depression has also been shown to be associated with poorer child cognition especially if the depression is chronic and the child is at additional risk from low socio-economic status (Murray et al, 1992), male sex (Sharp et al, 1995; Murray 1992; Kurstjens & Wolke, 2001) or poor neonatal health (Kurstjens & Wolke, 2001). Depression of the mother has also been found to be associated with poor school achievement in school age children (Salt et al, 1988).
The effects of maternal depression on child developmental outcomes are believed to be mediated through the poorer quality of parenting evident in depressed mothers. A study of single, black mothers of preschool age children showed that low income and low levels of social support were associated with increased financial stress which in turn was associated with high levels of maternal depression. Maternal depression was found to be associated with both behaviour problems and poor school readiness and the effect was mediated by the quality of the home environment as measured by the Home Observation for Measurement of the Environment (HOME) scale (Jackson et al, 2000).

*Parenting Self-Esteem*

The term self-esteem refers to the extent to which one values or likes oneself and according to Ozer & Bandura (1990) is:

"*concerned with the motivation, cognitive resources and courses of action needed to exercise control over given events.*"

pp: 472.

Parenting self-esteem is determined by three related factors: 1. knowledge of appropriate child care actions; 2. confidence in one’s ability to carry out the actions and 3. a belief that the child will respond to the action and that others will be supportive of it (Coleman & Karraker, 1997). Self-esteem is a central mediator between quality of parenting and a range of risk factors including depression, low social support, difficult child temperament and poverty and has been shown to explain a large amount of the variance in parenting skills (Teti & Gelfand, 1991). The effects of self-esteem are thus particularly important for those who live in disadvantaged environments and those with a significant amount of adversity in their life and high parenting self-esteem can act as a buffer or protective factor for children and mothers at psycho-social risk. High parenting self-efficacy is associated with better coping skills, increased maternal sensitivity and responsivity, provision of a more stimulating environment and non-punitive caretaking (Coleman & Karraker, 1997).
Chronic Stressors
Chronic stressors include financial strain, violent neighbourhoods, problematic interpersonal relationships, inadequate housing and poor health and these are pervasive influences in the lives of many disadvantaged families. Parents who are preoccupied and anxious and are struggling to cope with the levels of adversity in their life are less emotionally available to their children and less likely to be able to provide sensitive and nurturing parenting (Atkinson et al, 2000). For example, parents experiencing chronic stressors are less sensitive to their infant’s cues (Crnic et al, 1983) and have poorer parenting attitudes (Hall et al, 1991). Difficult infant temperament can also act as a stressor and can lead to low parenting self-efficacy and depression (Cutrona & Troutman, 1986).

1.2.3. Summary of Child Development and Parenting
Both child development and parenting quality are multi-determined and are influenced by factors within the individual and by the proximal and distal environment. Risk factors tend to cluster together and families living in disadvantaged circumstances are usually exposed to multiple risk which will negatively affect the quality of parenting provided by the mother and child development and behaviour.
1.3. Undernutrition and Child Development and Behaviour

Previous classifications of undernutrition were based on weight for age and the presence of oedema (Gomez, 1955; Welcome Trust Working Party, 1970). However, these classifications do not differentiate between chronic and acute malnutrition and hence Waterlow et al (1974) proposed the use of weight for height and weight for age to distinguish between stunting (chronic malnutrition) and wasting (acute malnutrition). Undernutrition is currently diagnosed when measures of weight for age, height for age or weight for height are below -2 standard deviations of internationally accepted references (Hamill et al, 1977). Moderate underweight indicates weight for age below -2 standard deviations (SDs), moderate stunting indicates height for age below -2 SDs and moderate wasting, weight for height below -2SDs. Below -3SDs indicates a severe condition.

Undernutrition was previously referred to as protein energy malnutrition. However, when children are undernourished due to low dietary intakes of energy and protein their diets are usually also deficient in many micronutrients (Schurch, 1995) and hence the term undernutrition is more appropriate.

Although there has been some decline in the prevalence of childhood undernutrition it remains extremely high. It is estimated that 33% of children under 5 years in developing countries are moderately stunted and 10% moderately wasted (UNICEF, 2001). Research has been conducted on the effect of undernutrition on children's development for several decades and there is now a considerable amount of evidence indicating a causal relationship between undernutrition and poor development. This literature will be reviewed in this section which includes the following:

- A short discussion of the risk factors that covary with child undernutrition
- A review of observational studies of undernutrition and child development
- A review of preventative and remedial supplementation studies
- A review of studies of psychosocial stimulation with undernourished children
- A short discussion of the effects of zinc supplementation on child development.
1.3.1. The Context of Malnutrition

Studies in developing countries have shown that undernutrition covaries with low socio-economic status and poor quality of parenting. For example, children are more likely to be undernourished if the mother has lower levels of education (Graves 1976, 1978; Vella et al, 1994; Coulter et al, 1988), if the father is not present (Goodall, 1979; Dixon et al, 1982) and if they live in homes with lower levels of income (Goodall, 1979; Vella et al, 1994; Rikimaru et al, 1998; Begin et al, 1999). These features which characterize the context in which undernourished children live are also risk factors for poor parenting and poor child developmental outcomes.

Other factors which act to compromise parenting ability were discussed in the previous section and include poor mental health, low self esteem, low levels of support and contextual sources of stress and few studies have examined these factors in relationship to child malnutrition. Two studies reported increased depressive symptoms in mothers of previously undernourished children. In Barbados, mothers of 5-11 year old children who had been severely malnourished in the 1st year of life were more likely to be depressed than a control group but this difference was explained by low socioeconomic status (Salt et al, 1988). De Andraca et al (1990) reporting on a follow up of a preventive trial of iron deficiency anaemia found more severe and longer lasting depressive symptomology amongst mothers of 5-6 year old children who had iron-deficiency anaemia in the 1st year of life. There were no significant differences between the groups on measures of life stress. There is however no clear evidence of poor psychosocial function amongst mothers of currently undernourished children in developing countries. Begin et al (1999) measured a wide variety of caregiver characteristics and socio-economic factors and reported that younger child age, low household income, less maternal influence in decisions regarding child feeding, having no help available for household tasks and low satisfaction with life were significant predictors of low height for age in 1 to 6 year old children in rural Chad. This study suggests that social support (help available) and mental health (life satisfaction) may be important risk factors present in the environments of undernourished children. However, these variables were dichotomous and may show small or no correlations with more comprehensive indices of support and psychosocial function. A few studies with failure to thrive
children in developed countries have examined the psychosocial characteristics of mothers but the results have been inconclusive (Boddy & Skuse, 1994).

Undernourished children have thus been shown to experience multiple deprivation which could contribute to poor development. However, the extent of this deprivation is not clearly defined.

1.3.2. Observational studies of undernourished children

**Concurrent cognition and school achievement:**
A large number of cross sectional studies have shown an association between stunting or low weight-for-age and poor motor and mental development in early childhood (Lasky et al, 1981; Monckenberg, 1972; Powell & Grantham-McGregor, 1985; Sigman et al, 1989) and poor cognition and school achievement in later childhood (Clarke et al, 1991; Moock & Leslie, 1986; Sigman et al, 1989b). Associations between wasting and development are less often found than associations between stunting and development (Grantham-McGregor, 1995)

**Concurrent behavioral differences:**
Children hospitalized for severe malnutrition have been shown to be less active, more apathetic, less exploratory and show less active distress in the acute stage than children hospitalized for other diseases (Grantham-McGregor et al, 1991b). These behaviors returned to normal with recovery except for the quality of exploration which remained poor. Moderately undernourished children also show altered behavior. In young children, these behaviours include increased fussing and/or crying (Meeks-Gardner et al. 1999; Allen 1993) lower activity level (Meeks-Gardner et al. 1995), less sociability (Whaley et al, 1998) less amount and enthusiasm of play and exploration (Graves, 1976, 1978; Meeks Gardner et al, 1999), fewer vocalisations (Sigman et al, 1989; Klein et al, 1974), less positive affect (Meeks-Gardner et al. 1995; Allen 1993) and a tendency to stay closer to the mother (Grantham-McGregor et al, 1989b; Graves 1976; Graves 1978) and be more apathetic (Allen 1993).
However, the disadvantaged environments experienced by undernourished children may independently effect children's development and furthermore may modify the effects of undernutrition. The children's disadvantaged backgrounds thus confound the interpretation of cross-sectional studies and the temporal relationship between undernutrition and poor development is unknown. These studies will not be discussed further. Longitudinal studies give an idea of relationships over time.

**Longitudinal studies of severe malnutrition**

*Associations between growth and change in development:*

Two studies found an association between linear growth and change in development. In Guatemala, change in height from 6 to 24 months of age was associated with change in development (Lasky et al, 1981). In Jamaica, stunted children were enrolled between 6 and 24 months and change in height over the subsequent 24 months of the study was associated with change in mental age. Furthermore, change in height in the first 12 months predicted change in mental age in the second 12 months even after controlling for height change in the second year (Powell et al, 1995).

*Follow-up of children with severe clinical malnutrition in early childhood:*

Children hospitalised for severe malnutrition in early childhood in developing countries have been found to have long-term deficits in cognitive development and school achievement up to adolescence. Studies compared previously severely malnourished children with matched controls and/or with siblings. In eight out of nine studies reviewed using matched controls the previously malnourished children performed significantly worse on cognitive tests than children without a history of malnutrition (Champakan et al, 1968; Cravioto & Delcardie, 1975, Hoorweg & Stanfield, 1976; Galler et al, 1984; Galler et al, 1986; Richardson et al, 1973, Grantham-McGregor et al, 1987; Nwuga, 1977). Only one study, in South Africa (Bartel et al, 1978) showed no difference between the groups.

Studies with siblings have produced less consistent results. Siblings of previously malnourished children performed significantly worse on intelligence tests than their siblings in Mexico (Birch et al, 1971), Jamaica (Hertzig et al, 1972; Richardson et al,
1973), Lebanon (McLaren et al, 1973) and Nigeria (Nwuga, 1977). A study in South Africa (Evans et al, 1971) showed no difference on an intelligence test between the groups although the index children did perform worse than their siblings on a drawing test.

In other studies, school grades have been used as the outcome measure. One study found significantly worse school grades in the previously malnourished group (Pereira et al, 1979) whereas in two other studies no differences were found (Graham & Adrianzen, 1979; Moodie et al, 1980). Although comparisons with siblings ensure children are matched for social background and family characteristics, the siblings are likely to have suffered from moderate malnutrition themselves.

**Follow-up studies of children with stunting in early childhood:**
Six longitudinal studies of children who were stunted in early childhood were found and in all studies, early stunting was associated with cognitive or school achievement deficits at follow up at varying ages from 5 years to adolescence. Deficits in a broad range of measures were reported. In Guatemala (Martorell et al, 1992), early stunting was associated with deficits in literacy, numeracy, general knowledge and maximum school grade reached at 18 years or older in both sexes and reasoning (Ravens matrices) in boys only. In Jamaica (Walker et al, 2000), at 11 to 12 years of age, deficits were found in a wide range of cognitive tests including IQ, reasoning, vocabulary, verbal analogies, visual-spatial working memory, ability to recall strings of numbers in reverse order, sustained attention and information processing. They also had poorer school achievement (Chang et al, in press). From the range of tests, only auditory working memory for strings of numbers was not affected. In an earlier Jamaican study, deficits were also found in school achievement (Richardson, 1979). In the Philippines (Mendez & Adair, 1999), early stunting was associated with low IQ and school drop out, grade repetition and absenteeism at 11 years. In Kenya, early height and weight were associated with vocabulary and reasoning (Raven's matrices) at 5 years (Sigman et al, 1991) and in Peru severe stunting in the second year of life was associated with low IQ at age 9 years.
Long term behavioural effects:

Behaviour anomalies persist until later childhood and adolescence. Jamaican children with early stunting were found to be more inhibited and less attentive at age 7-8 years (Fernald & Grantham-McGregor, 1998) and had more conduct disorders at age 11-12 years (Chang et al, in press). Children hospitalised for malnutrition in the first year of life were found to have poorer behaviour in school including attention deficits and poor social skills at age 5-11 years (Galler & Ramsey, 1985) and were more distractible at home and had greater attention deficits in school at 9-15 years (Galler & Ramsey, 1989) than children with no history of malnutrition. Younger children were observed to play less and stay closer to their mothers and be more unresponsive when given a task (Grantham-McGregor et al, 1989b).

1.3.3. Supplementation Studies

As undernutrition covaries with a range of other factors which are known to effect child development the strongest evidence linking malnutrition to poor development comes from supplementation studies which can rule out these confounding covariates (depending on the rigour of the study design). These studies may be divided into preventative ones, which began in pregnancy or at birth and remedial ones, which targeted children who are already undernourished. The details of the more important studies are given in Table 1.1. and 1.2. Studies which involved supplementation and stimulation are reviewed in the next section.

Preventative Interventions

In four studies, supplementation was initiated in pregnancy and resulted in improved concurrent developmental levels for the children. These studies are described in detail below and are summarised in Table 1.1.

In Taiwan (Joos et al, 1983), pregnant women were randomly assigned to receive a supplement of energy, protein and micronutrient or a placebo of micronutrients only during pregnancy and lactation. At 8 months, infants in the treatment group scored higher on the psychomotor development index of the Bayley although no effect was found on mental development. Follow up at age 5 years showed no lasting benefits of supplementation to child IQ (Hsueh & Meyer, 1981).
In a study in Bogota, Columbia (Waber et al, 1981), pregnant women ‘at risk’ for having a malnourished child were randomly assigned to one of six groups. One group acted as a control and received no intervention (group A), one group was supplemented from six to 36 months of age (group B), one was supplemented from the last trimester of pregnancy to six months of age (group C) and a fourth group was supplemented over the whole period, that is, from pregnancy to 36 months of age (group D). Group E received a combined intervention of nutritional supplementation from pregnancy to 36 months of age and a maternal education program from birth to 3 years and Group F received the maternal education program alone. The results from the latter two groups will be discussed in section 1.3.4. Supplementation up to 36 months of age (groups B & C) was found to benefit all subscales of the Griffiths test and total DQ. No benefit was found at 36 months of supplementation from pregnancy to 6 months only.

Follow up at age 6-7 years showed that supplementation up to 36 months benefited scores on reading readiness and this was primarily for mothers with a high level of psychological and social resource (Super & Herrera, 1991). No benefit was found from intervention on arithmetic or knowledge. Supplementation was also found to benefit infant behaviour - infants in the non-supplemented group were more irritable and more likely to cry on nipple removal at 15 days and were more apathetic at 4 months than infants receiving supplementation (Mora et al, 1979).

In Mexico, 17 mothers were supplemented through pregnancy and lactation and the children were supplemented until age 10 (Chavez and Martinez, 1982). The children in the supplemented group achieved higher scores on the Gesell scales from 3 to 24 months of age than a control group who did not receive supplementation. School achievement in primary school was also higher for the supplemented group. Supplemented children were also found to have increased activity levels, more play behaviour, increased vocalisations, less crying, more independence and protested more about being restricted (Chavez, Martinez and Yaschine, 1975). Follow up of this study when the children were aged 12 through to 18 years showed that the supplemented group retained their developmental advantage (as measured by the
Terman-Merill test) and by age 18 years a higher score on Raven’s Matrices was found for supplemented boys only (Chavez et al, 1994).

In Guatemala, four villages were randomly assigned to receive either Atole, a high energy, high protein supplement with micronutrients or Fresco, a low energy, low protein supplement with micronutrients (Freeman et al, 1977). Supplement was available to everyone in the village twice daily in special feeding centres but only pregnant and lactating mothers and children up to age 7 were included in the study. There has been some controversy about the analysis of the results from this study and the data analysis was repeated by Pollitt et al (1993) to retain the original study design. Children in the Atole villages were more advanced in motor skills at 24 months than children in the Fresco villages and performed better on test of perceptual organisation and verbal ability at age 4 and 5 years after controlling for sex, age and attendance. At age 4 & 5 the interaction between treatment x socio-economic status (SES) was significant indicating that the supplement was most beneficial to children of low socio-economic status.

Further follow up was conducted when the children were in adolescence and a range of psychoeducational and information processing tests were used. The Atole group scored significantly higher than the Fresco group on numeracy, knowledge, vocabulary and reading and there was a treatment x SES interaction for all of the above tests and for Raven’s Matrices showing that the additional benefits to children of low SES were sustained. In addition there was a treatment x maximum grade reached interaction at this age showing that supplementation was particularly beneficial to those with more schooling. Fewer benefits of Atole were found on tests of information processing with children in the Atole group performing better on only two out of seven tests.

In another analysis from the same study, children were classified into two groups (high supplementation and low supplementation) according to the level of maternal supplementation during pregnancy and child supplementation from birth to 4 years. Children in the high supplementation group were more exploratory, more persistent, more involved and active, less anxious and displayed more affective expression (both positive and negative) in a range of structured and unstructured situations (Barret et
al, 1982; Barrett & Radke-Yarrow, 1985). However, the method of data analysis used in this report resulted in the initial randomized study design being lost.

There were however, problems with the study design in some of the above preventative supplementation trials. In Mexico, group assignment was not random and the groups were separated by time. In the Guatemalan study, only four villages were used in the randomisation and differences were found between the villages on key characteristics such as paternal occupation and literacy and quality of schooling. In addition, the supplements differed in appearance and taste and hence the intervention was not blind. Supplement was consumed on a self-selection basis and differential attendance rates were found in the villages although this was controlled for in the analysis. Only in Taiwan was a true placebo given. In addition, as all of the studies involved supplementation of mothers, it is unclear if the benefits to the children can be ascribed to the supplement per se or are due to changes in maternal behaviour.

**Remedial Interventions**

The studies of remedial interventions for undernourished children reported less consistent results. Four studies were reviewed and are summarized in Tables 1.1. and 1.2. Two involved psychosocial stimulation (Grantham-McGregor et al, 1991; McKay et al, 1978) and are described more fully in the next section.

In a study in Indonesia, Husaini et al (1991) reported that 113 nutritionally at risk children aged 6 – 20 months of age, attending 20 day care centres, were randomly assigned to receive supplementation or a control group. Randomisation took place at the level of the day care centre and treatment lasted for 90 days. Supplementation benefited motor but not mental scores on the Bayley scales of mental development. However, the original sample included children up to age 60 months but no benefit was found for those over 20 months of age on enrolment (Grantham-McGregor & Ani, 2001). At follow up when the children were aged 9 years, the only benefits sustained from a battery of 4 tests was in one test of working memory and this only for children supplemented before the age of 18 months (Pollitt et al, 1997).
A recent study in Indonesia (Pollitt, 2000) involved supplementing undernourished children attending day care centres. There were two age cohorts (a 12 month and 18 month old cohort) randomised to three groups: E were given condensed milk with micronutrients, M were given micronutrients and skimmed milk and S were given a skimmed milk only. In the 12 month cohort the E group were significantly more advanced in motor milestones and a Piagetian type object concept test than the M & S groups. There were however no significant differences between the groups on the Bayley scales of development. In the 18 month cohort, the E group scored significantly higher on the Bayley Mental scale than the M group but there were no significant differences between E & S. Children in the E group were also found to exhibit more developmentally adaptive behaviours including playing and talking more and fussing less (Pollitt et al, 2000) and they waited less to begin play, played with more toys, had longer spans of play and breastfed less (Walka et al, 2000) than children in the M and S groups.

In a study in Jamaica, supplementation was provided for stunted children aged 9-24 months for 2 years and concurrent benefits were obtained on treatment (Grantham-McGregor et al, 1991). The children were followed up at age 7-8 years and small global benefits were found (Grantham-McGregor et al, 1997) but these benefits were not sustained at age 11-12 years (Walker et al, 2000). In addition, there was no benefit from supplementation to child behaviour (Meeks-Gardner et al, 1995; 1999). In a study in Cali, children were recruited at age 3½ and no concurrent or long term benefits of supplementation alone were found (McKay et al, 1978).

**Conclusion of Supplementation Studies**

The preventative supplementation trials showed that for populations at risk for undernutrition, supplementation in pregnancy followed by supplementation of children for at least 3 years resulted in concurrent and long term benefits on children's development (Waber et al, 1981; Chavez & Martinez, 1982; Pollitt et al, 1993). However, while supplementation of women in pregnancy and lactation alone concurrently benefited child development, there was no evidence of a sustained benefit (Joos et al, 1983). In addition, a meta-analysis by Pollitt & Oh (1994), reported that supplementation more consistently benefited motor development than
mental development in the first two years of life. This may be a reflection of the type of test used. However, it may be that longer periods of supplementation are required to benefit mental development, for example, in the Jamaican study with stunted children (Grantham-McGregor et al, 1991), supplementation only benefited motor performance in the 1\textsuperscript{st} year but in the 2\textsuperscript{nd} year benefits also appeared in the performance subscale. Three studies included measures of child behaviour and in all three benefits of supplementation were found (Waber et al, 1981; Barrett & Radke-Yarrow, 1985; Chavez et al, 1976).

The effects of remedial interventions for undernourished children are less clear. In the only study in which supplementation began after age 3 years, no concurrent or long term benefits were found for children’s development (McKay et al, 1978). In the three studies involving supplementation of children before the age of 24 months (Husaini et al, 1991; Grantham-McGregor et al, 1991; Pollitt et al, 2000) concurrent benefits to child cognition were obtained on treatment. Two of these studies have reported long term follow up and in one some benefit was sustained but only for children supplemented before the age of 18 months (Pollitt et al, 1997) and in the other, although small benefits were found at age 7-8 years (Grantham-McGregor et al, 1997), the benefit was not sustained until age 11-12 years (Walker et al, 2000). Two studies reported the effects of supplementation on child behaviour and one found a benefit for children receiving a high calorie supplement and micronutrients (Pollitt et al, 2000) and the other found no benefit (Meeks-Gardner et al, 1999).
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</table>
| Taiwan                 | Pregnant women randomised to supplement or placebo. Supplement provided from pregnancy through lactation to mother only | **Supplement**: 800 kcals 40g protein/day and vitamins and minerals  
**Placebo**: 6 kcals/day + vitamins & minerals, later changed to 80 kcals/day | Child outcomes  
IQ: Treatment benefited motor but not mental development at 8 months. | Child outcomes  
IQ: No benefit at age 5 years to IQ. |
| Guatemala              | 4 villages randomised to Atole or Fresco supplement ad libitum.                | **Atole**: 91 kcal, 6.4g protein / 100ml + vitamins and minerals  
**Fresco**: 32 kcal, no protein / 100ml + vitamins and minerals | Child outcomes  
IQ: Atole benefited motor but not mental development at 24 months and perceptual organisation and verbal skills at age 4 & 5 years but not 3 and 6 years.  
Children of low SES benefited most. | Child outcomes  
IQ: At 13-19 years: Atole significantly better on 4/6 of the psychoeducational tests - numeracy, knowledge, vocabulary and reading in adolescence and in reasoning, and on two out of seven information processing tests – memory and paired associates. Low SES subjects benefited most.  
**Behaviour**: Children receiving high levels of supplementation were more exploratory, more persistent, more involved and active, less anxious and displayed more affective expression. |
| Bogota, Columbia       | High risk families randomised to 6 groups:  
A: control group  
B. Supplement from 6-36 mths  
C. Supplement from pregnancy to 6 mths  
D. Supplement from pregnancy to 36 mths  
E. Stimulation birth-36 mths  
F. No. 3 & No. 4 above  
Groups E & F reported in table 1.4. | **Supplement**: 856 kcals/day 38.4g protein + vitamins & minerals  
3-6 mths 125g/wk of skimmed milk + vegetable and protein mixture  
6-12 mths 1 lb whole dry milk 250g of high protein vegetable mix + iron  
>12 mths 623 kcals + 20g protein/day + vitamins & minerals | Child outcomes  
IQ at 36 months:  
Supplement benefited all of the Griffiths subscales and total DQ.  
**Behaviour**: At 4 months, supplemented children less apathetic.  
**Maternal outcomes**  
**Maternal behaviour**: No benefits of supplementation | Child outcomes  
School achievement:  
3½ years after intervention, supplementation benefited scores on reading readiness primarily for children with mothers with more psychological resources.  
No benefit on arithmetic or knowledge |
Table 1.1. Nutritional supplementation studies in developing countries

<table>
<thead>
<tr>
<th>Place</th>
<th>Study Design</th>
<th>Intervention</th>
<th>Concurrent Effects</th>
<th>Long Term Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mexico</strong></td>
<td>Chavez &amp; Martinez, 1982, 1981; Chavez et al, 1994</td>
<td>17 mother-child dyads supplemented compared with 17 unsupplemented in a previous year. Supplement provided through pregnancy and lactation and to children until age 10.</td>
<td><em>Child outcomes</em>&lt;br&gt;IQ: Supplemented children scored higher on Gesell tests of development from 3 to 24 months than non supplemented children.  &lt;br&gt;<em>Behaviour</em>: Children were also more active, exploratory &amp; sociable. &lt;br&gt;<em>Schooling</em>: Supplement benefited school achievement &amp; behaviour in primary school.</td>
<td><em>Child outcomes</em>&lt;br&gt;IQ: At age 18, supplemented boys but not girls, significantly better in reasoning (Ravens matrices) than controls.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supplement&lt;br&gt;Mothers: 64g/ day half-skimmed milk in pregnancy (400 kcal), whole milk in lactation (600 kcal). 3-4 mths began milk &amp; strained foods ad libitum From 4-10 years: meat or cheese sandwich and milk twice daily</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Indonesia</strong></td>
<td>Husaini et al, 1991; Pollitt et al, 1997</td>
<td>20 day care centres randomised (113 children 6-59 mths) to treatment/ no treatment for 90 days</td>
<td><em>Child outcomes</em>&lt;br&gt;IQ: Supplement benefited motor but not mental scores on the Bayley in children &lt;20 mths but not older ones.</td>
<td><em>Child outcomes</em>&lt;br&gt;IQ: No overall effect but children initially &lt;18 mths benefit in 1/4 cognitive tests – a test of working memory.  &lt;br&gt;<em>Educational Tests</em>: No difference in arithmetic or PPVT (verbal comprehension).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supplement: 400 kcal, 5g protein + vitamins and minerals</td>
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</table>
## Table 1.2. Nutritional supplementation in developing countries

<table>
<thead>
<tr>
<th>Place</th>
<th>Study Design</th>
<th>Intervention</th>
<th>Concurrent Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>20 day care centres stratified by size &amp; quality and randomised to one of 3</td>
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<tr>
<td></td>
<td>treatments E = high energy, M = micronutrients, S = control</td>
<td><strong>E</strong> = condensed milk + vitamins &amp; minerals</td>
<td><strong>Child outcomes</strong></td>
</tr>
<tr>
<td>Pollitt et al,</td>
<td></td>
<td>280 kcals 6g protein</td>
<td><strong>IQ:</strong></td>
</tr>
<tr>
<td>2000;</td>
<td></td>
<td><strong>M</strong> = skimmed milk + vitamins &amp; minerals</td>
<td><em>In 12 mth cohort:</em></td>
</tr>
<tr>
<td>Jahari et al,</td>
<td></td>
<td>50 kcals 1.35g protein</td>
<td>E group significantly better than M &amp; S in acquisition of motor milestones and in a</td>
</tr>
<tr>
<td>2000;</td>
<td></td>
<td><strong>S</strong> = 25 kcals + 1.35g protein skimmed milk</td>
<td>Piagetian style object concept test.</td>
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<tr>
<td>Walka et al,</td>
<td></td>
<td></td>
<td>E and M group decline less on Bayley motor scale than S.</td>
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<tr>
<td>2000</td>
<td>2 cohorts: 12 mths (n = 53) &amp; 18 mths (n = 83) followed for 12 mths. S followed</td>
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<tr>
<td></td>
<td>for 6 mths</td>
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<td><strong>In 18 mth cohort:</strong></td>
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<tr>
<td></td>
<td>HAZ ≤ -1z scores</td>
<td>E group significantly higher mental development scores than M but no difference between E &amp; S.</td>
<td>E group significantly higher mental development scores than M but no difference between E &amp; S.</td>
</tr>
<tr>
<td></td>
<td>WHZ -1 to -2z scores</td>
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<td></td>
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<td><strong>Pooled cohorts:</strong></td>
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<td></td>
<td></td>
<td>The E group performed better than the M group in Bayley mental scores across evaluations.</td>
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<td></td>
<td></td>
<td><strong>Behaviour:</strong></td>
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<td></td>
<td></td>
<td><em>In 12 month cohort:</em></td>
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<tr>
<td></td>
<td></td>
<td>E group vocalized more, played for longer periods and fussed less than S</td>
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<tr>
<td></td>
<td></td>
<td><strong>In 18 month cohort:</strong></td>
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<tr>
<td></td>
<td></td>
<td>E group vocalized more than S. E &amp; M group played for longer periods than S. E group manipulated objects more than M.</td>
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<tr>
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<td><strong>Pooled cohorts:</strong></td>
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<tr>
<td></td>
<td></td>
<td>E group fussed less than M &amp; S groups. M carried more than E and S.</td>
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</tbody>
</table>
1.3.4. Psychosocial Stimulation with Undernourished Children

Several studies have examined the effect of psychosocial stimulation with or without supplementation on the development of undernourished children. These studies are reviewed in this section and are summarized in Table 1.2.

In the Bogota study discussed earlier, two of the six groups were randomised to receive a maternal education intervention. One group received maternal education alone and another received the maternal education in addition to supplementation from pregnancy through to age 3 (Waber et al, 1981). The maternal education component involved home visits by primary school teachers twice per week from birth to age 3. At age 3, maternal education benefited only the hearing and speech subscale of the Griffiths test. There was no significant interaction between supplementation and education but there was an interaction between education and child age – the effect of maternal education declining with age. Infants in the education group also performed significantly better on a Piagetian style test at 4 and 6 months but not later and there was a significant interaction between supplementation and stimulation at this age.

In a follow up at age 6-7 years there were no sustained benefits of maternal education, although there was a hint of benefit to reading readiness for boys only (p < .07) (Super & Herrera, 1991). However, the follow up is reported in an abstract only and hence no details are available to evaluate the study.

Maternal education produced no concurrent gains on child nutritional status but at age 6 a significant benefit was found for linear growth (Super et al, 1990). The authors suggested that mothers receiving the home visiting intervention may have adopted better feeding practices resulting in improved nutritional status of the children.

In a study in Cali, Columbia (McKay et al, 1978), 301 undernourished 3 year old children were stratified by neighbourhood and the neighbourhoods randomly assigned to one of five treatments. Treatment involved from one to four 9 month interventions of a combined health, nutrition and stimulation intervention at a day care centre and one group which received health and nutrition only prior to one 9 month combined intervention. This latter group performed no better at age 7 than the group receiving one
period of combined treatment indicating that supplementation alone did not measurably benefit the children's development. At age 7 years, the combined intervention improved general cognitive ability in proportion to the number of treatment periods received (Figure 1.3.). Children receiving treatment also performed better than a group of adequately nourished children from the same neighbourhoods but performed worse than children from high SES backgrounds. At follow up, one and two years after the end of the intervention, the IQ of the children was also directly related to the duration of intervention.

Figure 1.2. Dose–Response Effect on Child Cognition of a Combined Health, Nutrition and Stimulation Intervention in Cali, Colombia

Height and weight gain were also directly related to the duration of the intervention throughout the study period although at follow up three years later, when the children were 10 years old, no benefits of intervention on growth were evident (Perez-Escamilla & Pollitt, 1995).

The only intervention specifically targeting stunted children was conducted in Jamaica (Grantham-McGregor et al, 1991). 129 moderately or severely stunted children aged 9 – 24 months were randomly assigned to one of four treatment groups – stimulation,
supplementation, supplementation and stimulation or control. An additional group of 32 non-stunted children, matched for age and sex with the control group, were enrolled as a comparison group. The intervention lasted for 2 years. Supplementation was provided for the whole family on a weekly basis and stimulation involved weekly home visits from a trained paraprofessional.

Over the two years of intervention, stimulation benefited DQ and all the subscales while supplementation benefited DQ and the performance and locomotor subscale. Supplementation and stimulation combined had an additive rather than interactive effect and the children receiving the combined intervention caught up with the non-stunted children by the end of the intervention period (Figure 1.4.).

Figure 1.3. Developmental Quotients of Stunted Jamaican Children from Baseline to 24 Months by Intervention Status

Child behaviour was assessed through home observations at baseline and after 6 months of intervention and no benefits of supplementation or stimulation were found on measures of activity, affect and the quality and quantity of exploration (Meeks-Gardner et al, 1995; 1999). Supplementation benefited height and weight with younger children benefiting the most. No effects of stimulation on child nutritional status were found (Walker et al, 1991).
At age 7-8 years, children were evaluated on a battery of tests assessing cognitive function, fine motor skills and school achievement. Factor analysis of the scores from these tests resulted in three factors: general cognitive function, perceptual motor skills and memory. The groups receiving supplementation and/or stimulation performed significantly better than the control group on more of the developmental tests than expected by chance although differences for the individual tests were not significant (Grantham-McGregor et al, 1997). There was also an interaction between maternal PPVT and supplementation on the factor representing general cognitive function indicating that supplementation was particularly beneficial for children whose mothers had a higher verbal IQ. There was also a main effect of stimulation on a factor score representing perceptual motor skills.

There was no effect of stimulation or supplementation on child nutritional status at this time point (Walker et al, 1996).

A further follow up at 11-12 years (Walker et al, 2000; Chang et al, in press) showed no lasting benefit of supplementation although the group receiving stimulation and the combined intervention group had significantly better scores on the Ravens matrices, vocabulary and the WISC-R full scale and verbal scale than the controls. Intervention had no significant benefits to school achievement or child behaviour as assessed through parent and teacher ratings.

An intervention study involving stimulation, this time with severely malnourished children was also conducted in Jamaica (Grantham-McGregor et al, 1987). 16 severely malnourished children were played with daily while in hospital and this was followed by weekly home visits for 2 years and fortnightly visits for a further 1 year. The development of these children was compared with that of 18 severely malnourished children enrolled a year previously who received no stimulation and a group of 21 adequately nourished children in hospital for other reasons. The children in the intervention group had higher scores on the Griffiths test up to 60 months and higher IQ scores at age 60 & 70 months than children in the control group and 2 years after leaving hospital their development caught up with that of the adequately nourished group.
The behaviour of the children was also assessed in a laboratory setting at the end of the 3 year intervention period and the non-intervened malnourished group stayed closer to their mother and stopped play sooner than the other two groups (Grantham-McGregor et al, 1989b). The intervened malnourished group behaved similarly to the adequately nourished group. It was hypothesised that the less appropriate play behaviour displayed by the non-intervened group contributed to the continuation of their developmental deficits. The children were followed up from 7 and 14 years after leaving hospital (Grantham-McGregor et al, 1994). After controlling for current height, SES and child age, children in the intervention group scored significantly higher on the WISC full scale and verbal subscale than the control children.

Figure 1.4. Developmental Levels of Severely Malnourished Jamaican Children until Adolescence

DQ/IQ z-scores

There were no significant differences between the groups on the performance subscale and PPVT. Differences in school achievement between the groups were not significant after controlling for SES, sex and age. There were also no differences between the intervened and non-intervened groups in anthropometry at any time.
Conclusion of Studies Involving Psychosocial Stimulation

Remedial studies with undernourished children involving stimulation (with or without supplementation) have had more success than the nutritional supplementation programmes in improving child cognition with three out of four of them producing concurrent and long-term benefits for children (Grantham-McGregor et al, 1987; Grantham-McGregor et al, 1991, 1997; Walker et al, 2000; McKay et al, 1978). The study in Bogota (Waber et al, 1981) showed very limited concurrent benefits of stimulation and as no details of the education intervention have been published it is difficult to ascertain if this is due to poor quality of this aspect of the intervention. Two studies reported benefits to child behaviour from a program of psychosocial stimulation (Grantham-McGregor et al, 199b; Mora et al, 1979), while one reported no benefits (Meeks-Gardner et al, 1999) although the observations were conducted after only 6 months of intervention and it may be that a longer period of intervention would be required to produce an effect.

1.3.5. Summary of Intervention Programs with Undernourished Children

In conclusion, nutritional supplementation programmes for infants and young children do have the potential to reduce developmental deficits and there is some evidence to suggest that supplementation is most effective if begun before the child is 24 months old. However, for greatest effect these programmes should be combined with early stimulation programmes which assist parents and health providers to promote child development through developmentally appropriate activities.
### Table 1.2. Remedial interventions with undernourished children involving nutritional supplementation and/or stimulation in developing countries

<table>
<thead>
<tr>
<th>Study Design</th>
<th>Intervention</th>
<th>Concurrent Effects</th>
<th>Long-term Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Jamaica</strong></td>
<td><strong>Supplementation:</strong> 1kg milk based formula/week giving 750 kcal, 20g protein daily</td>
<td><strong>Child outcomes</strong> IQ at 24 months: Supp. benefited DQ, performance and locomotor subscales <strong>Stim.</strong> benefited DQ and all 4 subscales <strong>Stim.</strong> and supp. had an additive effect <strong>Behaviour:</strong> No benefits of supp. or stim. after 6 months of intervention <strong>Nutritional status:</strong> Supp. benefited height and weight and there was a significant supplementation x age interaction with younger children benefiting the most. <strong>Stim.</strong> had no effect on growth.</td>
<td><strong>Child outcomes</strong> IQ: At 7-8 years: Supplementation and stimulation benefited significantly more tests than would be expected by chance but no significant differences on any one test. <strong>Stim.</strong> also benefited perceptual motor function. <strong>At 11-12 years:</strong> No benefit from supp. <strong>Stim.</strong> had benefits in reasoning (Raven's matrices), vocabulary and IQ on the WISC-R and verbal but not performance subscale. <strong>Schooling:</strong> No significant benefits on school achievement &amp; other cognitive tests. <strong>Nutritional status:</strong> No long-term benefits of supplementation or stimulation on growth were found at follow up.</td>
</tr>
<tr>
<td><strong>Grantham-McGregor et al, 1991, 1997</strong></td>
<td><strong>Stimulation:</strong> Weekly home visits from a trained paraprofessional</td>
<td><strong>Child outcomes</strong> IQ:</td>
<td><strong>Student outcomes</strong></td>
</tr>
<tr>
<td><strong>Walker et al, 1991, 1996, 2000</strong></td>
<td><strong>Placebo:</strong> home visits only</td>
<td>IQ at 24 months: Supp. benefited DQ, performance and locomotor subscales</td>
<td>IQ: At 7-8 years: Supplementation and stimulation benefited significantly more tests than would be expected by chance but no significant differences on any one test. <strong>Stim.</strong> also benefited perceptual motor function. <strong>At 11-12 years:</strong> No benefit from supp. <strong>Stim.</strong> had benefits in reasoning (Raven’s matrices), vocabulary and IQ on the WISC-R and verbal but not performance subscale. <strong>Schooling:</strong> No significant benefits on school achievement &amp; other cognitive tests. <strong>Nutritional status:</strong> No long-term benefits of supplementation or stimulation on growth were found at follow up.</td>
</tr>
<tr>
<td><strong>Chang et al (in press)</strong></td>
<td>32 non-stunted children matched for age and sex</td>
<td></td>
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</tr>
<tr>
<td><strong>Bogota, Columbia</strong></td>
<td><strong>Supplement:</strong> Details provided in table 1.2. The 2 groups reported here are</td>
<td><strong>Child outcomes</strong> IQ:</td>
<td></td>
</tr>
<tr>
<td><strong>Waber et al, 1981; Super &amp; Herrera, 1991; Super et al, 1990; Mora et al, 1979</strong></td>
<td>Maternal education: Home visits twice a week from a primary school teacher</td>
<td>VA years after intervention, stimulation had a marginally significant effect on reading readiness for boys only.</td>
<td><strong>Maternal outcomes</strong> Schooling: 3½ years after intervention, stimulation had a marginally significant effect on reading readiness for boys only. <strong>Nutritional status:</strong> Stimulation benefited height for age at age 6.</td>
</tr>
<tr>
<td><strong>Details provided in table 1.2.</strong></td>
<td><strong>Nutritional status:</strong> No effect of stimulation on growth at age 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Maternal education</strong></td>
<td><strong>Stim.</strong> benefited hearing and speech subscale only at 36 months <strong>Child behaviour:</strong> Infants receiving stimulation cried less</td>
<td><strong>Schooling:</strong> No significant benefits on school achievement &amp; other cognitive tests. <strong>Nutritional status:</strong> No long-term benefits of supplementation or stimulation on growth were found at follow up.</td>
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<tr>
<td><strong>E. Maternal education from birth-36 mths</strong></td>
<td><strong>Maternal outcomes</strong></td>
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<tr>
<td><strong>F. Supplementation from pregnancy to 36 months + E above.</strong></td>
<td><strong>Maternal behaviour:</strong> Mothers in education group more attentive and responsive at 4 months</td>
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</tbody>
</table>
### Table 1.2. Remedial interventions with undernourished children involving nutritional supplementation and/or stimulation in developing countries

<table>
<thead>
<tr>
<th>Study Design</th>
<th>Intervention</th>
<th>Concurrent Effects</th>
<th>Long-term Effects</th>
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</thead>
<tbody>
<tr>
<td>Cali, Columbia McKay et al, 1979</td>
<td>301 undernourished children stratified by neighbourhood areas randomised to 5 treatments beginning at different ages</td>
<td>Treatment involved combined health, nutrition and stimulation 5 days/wk at center. T1a = 75 - 84 months T1b = as T1a with prior supplementation T2 = 63 - 84 months T3 = 52 - 84 months T4 = 42 - 84 months Supplement provided at least 75% of RDA for protein and calorie + vitamins and minerals</td>
<td>Child outcomes&lt;br&gt;&lt;strong&gt;IQ:&lt;/strong&gt; General cognitive ability improved with treatment in a dose-response manner. Supplementation and health care alone had no significant effect&lt;br&gt;&lt;strong&gt;Nutritional status:&lt;/strong&gt; Height and weight gain also increased with treatment in a dose-response manner.</td>
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</tbody>
</table>

| Jamaica Grantham-McGregor et al, 1987, 1994 | 3 groups in hospital aged 6 - 24 mths. NIM: severely malnourished with standard care (n = 18) WN: matched well nourished with standard care (n = 21) 1 year later: IM: severely malnourished with stimulation (n = 16) | Treatment: Daily play in hospital & 3 years of home visits (1/week for 2 years and 1/fortnight for 3rd year) No supplement after leaving hospital | Child outcomes<br><strong>IQ:</strong> 24 mths after leaving hospital: DQ of IM significantly better than NIM & IM group caught up to WN group. IM significantly higher IQ than NIM, 60 & 72 mths after leaving hospital.<br><strong>Behaviour:</strong> NIM stayed closer to mother and stopped play sooner than IM and WN after 3 years of study<br><strong>Maternal outcomes</strong><br><strong>Behaviour:</strong> No benefits of intervention to maternal behaviour | Child outcomes at 14 year follow-up<br><strong>IQ:</strong> IM had significantly higher WISC full scale IQ & verbal subscale but not better in the performance subscale or PPVT than NIM<br><strong>Schooling:</strong> No significant difference between IM & NIM in school achievement<br><strong>Nutritional status:</strong> No differences between the undernourished groups on nutritional status at any time. |
1.4. Possible mechanisms linking undernutrition to poor development

Evidence for the association between childhood undernutrition and poor development was presented in the previous section. Although the disadvantaged backgrounds of undernourished children contribute to their poor development, poor nutrition almost certainly plays a part (Pollitt et al, 1995). In this section, possible mechanisms linking undernutrition to poor development will be discussed.

One possible mechanism is that undernutrition may result in structural or functional impairment to the brain and central nervous system (Levitsky and Strupp, 1995; Levitsky & Strupp, 1995) and to an altered responsivity to stress (Fernauld & Grantham-McGregor, 1998).

Another proposed mechanism is the 'functional isolation' hypothesis (Levitsky, 1979). In this theory, undernutrition leads to a reduction in the activity level and the quality of explorations of the child and thus alters his / her interactions with the environment. This in turn leads to poor developmental outcomes. These altered behaviours may become habitual and continue after the child recovers from the episode of undernutrition.

The evidence of the association between undernutrition and child behavioural deficits has been reviewed in the previous section and a summary is provided in Table 1.3. There is also evidence that these behavioural deficits are associated with poor developmental outcomes (Meeks-Gardner et al, 1999, Whaley et al, 1998; Pollitt 2000b; Mora et al, 1979; Graves, 1978). For example, in Jamaica, stunted children were observed to be less active and happy and more apathetic and fussy and these behaviours were concurrently associated with child DQ and also predicted developmental change over 1 and 2 years (Meeks-Gardner et al, 1999). In Kenya, weight and height were positively associated with infant sociability at 6 months and sociability was associated with higher scores on the Bayley mental at 30 months and higher verbal comprehension at 5 years (Whaley et al, 1998).
A third possible mechanism linking undernutrition to poor development is through altered caregiver behaviour. Caregivers of undernourished children have been found to exhibit different parenting behaviours than caregivers of adequately nourished children although the precise nature of these behaviours varies across cultures (Wachs, 1992). For example, mothers of undernourished children have been found to provide less stimulation in the home (Sheffer et al, 1981; Grantham-McGregor, 1984), the quality of maternal-child interaction has been found to be poorer (Grantham-McGregor et al, 1991b, Meeks-Gardner et al, 1999; Pollitt et al, 2000; Sigman et al, 1989, Graves, 1976, Chavez & Martinez, 1982) and their child is less likely to form a secure attachment (Valenzuela, 1990). These maternal behaviours have been found to be related to poor development in undernourished children (Sigman et al, 1989; Pollitt et al, 2000b; Meeks-Gardner et al, 1999, Wachs, 1993; Chavez & Martinez, 1982). For example, caregivers of stunted children in Jamaica had poorer quality vocalizations characterized by more commands and less praise, affection and teaching than caregivers of non-stunted children (Meeks-Gardner et al, 1999). The quality of caregiver vocalization was positively associated with the children's language development. In Kenya and Egypt, toddlers with higher food intakes were held and carried less and carrying was negatively associated with child developmental levels (Wachs, 1992).

These altered behaviours of the caregivers of undernourished children may be a response to the child's behavioural deficits (Chavez & Martinez, 1982). Alternatively the altered behaviours may precede the onset of undernutrition. Only one prospective study was located that provides evidence of this. In Mexico, mothers of severely malnourished children were found to be less responsive and affectionate to their children, talk less to their child and provide poorer stimulation in the home preceding the onset of undernutrition (Cravioto and Delicardie 1976). Altered parenting behaviour may result from poor maternal nutrition (Wachs, 1992; Valenzuela, 1997). In addition, as the behaviours of mothers with poor psychosocial function and/or low levels of social support (see section 1.2.2.) are similar to those described in mothers of undernourished
children the altered behaviours of mothers of undernourished children may be a result of influences such as maternal psychiatric pathology and/or low sources of support.

These three proposed mechanisms linking childhood undernutrition to poor development are not mutually exclusive and each is likely to play a role. The enhanced responsivity to stress of the stunted children in the study by Fernauld & Grantham-McGregor (1998) was accompanied by behavioural deficits including more inhibited and less attentive behaviour. In addition, given the transactional nature of child development it is likely that both the behavioural deficits of the child and the poor parenting behaviours will interact with each other leading to a continuation of behavioural deficits and subsequent poor child development.
Table 1.3. Summary of the evidence for the association between undernutrition and young children’s behaviour

<table>
<thead>
<tr>
<th>Activity</th>
<th>Positive Emotionality</th>
<th>Negative Emotionality</th>
<th>Sociability</th>
<th>Fearfulness</th>
<th>Play and exploration</th>
<th>Vocalisations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undernourished children less active (Meeks-Gardner, 1995)</td>
<td></td>
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<td></td>
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<tr>
<td>Supplemented children more active (Chavez et al, 1976)</td>
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<td>Shorter Mexican preschoolers spend more time doing nothing (Allen, 1993)</td>
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<tr>
<td>Supplemented children more active (Chavez et al, 1976)</td>
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<td>Stunted children more fussing (Meeks-Gardner, 1999)</td>
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<td>Supplemented children decreased fussing (Pollitt, 2000)</td>
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<td>Smaller infants smile less at 3 &amp; 6 months (Allen, 1993)</td>
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<tr>
<td>Shorter Mexican preschoolers have fewer positive social interactions (Allen, 1993)</td>
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1.5. Zinc and Child Development

The prevalence of zinc deficiency is not known but it is common in populations who consume little meat and high levels of phytate and fibre which reduces zinc bioavailability. This diet is highly prevalent in many developing countries. Zinc is also lost from the body during episodes of diarrheal disease. Requirements for zinc increase during periods of rapid growth, for example, infancy and pregnancy. Therefore in many developing countries, where young children have poor diets and frequent diarrhea it is likely that zinc deficiency is present. Zinc deficiency is associated with reduced immunity to infection and increased severity and duration of diarrhea and growth retardation. There is some evidence that zinc deficiency also affects children’s cognitive and motor development and behaviour. In the following section, a brief review of the evidence of the effects of zinc on child growth, development and behaviour is given.

1.5.1. Growth

A recent meta-analysis of 33 randomised placebo-controlled trials investigating the effect of zinc supplementation on the growth of children aged 12 years or less found a significant effect of zinc supplementation on linear growth and weight gain but no effect on change in weight for height (Brown et al, 2002). The greatest gains were for children who were undernourished at enrolment as indexed by their height for age and weight for age z scores.

1.5.2. Child Development and Behaviour

Six randomized placebo-controlled trials which examined the effect of zinc supplementation on the behaviour and/or development of infants and toddlers were identified.

Bentley et al (1997) supplemented 6-9 month old Guatemalan infants with zinc for 7 months and observed their activity patterns at home. Infants in the supplemented group played more and were more likely to be sitting rather than lying down as compared to
non-supplemented children. There was no effect of zinc supplementation on the acquisition of motor milestones. In a study in India (Sazawal et al, 1996) 1 to 2 year old children were supplemented with zinc and vitamins or vitamins alone for a period of at least one month (although 70% of the sample received supplement for more than 120 days). Children receiving zinc were rated as being more active although further analysis revealed that the difference was significant for boys only.

Two studies investigated the effects of supplementation on the development of low birth weight infants.

In Brazil, low birth weight infants were supplemented daily from birth to 8 weeks with 1 or 5 mg of zinc and no difference was found in the mental or motor development of the children receiving zinc supplement and those receiving placebo at 6 and 12 months (Ashworth et al, 1997). However, significant differences favouring the zinc group were found on responsiveness during the developmental test session at 12 months.

In a study in Canada, very low birthweight children supplemented with zinc and copper for the first 6 months of life had improved motor development compared to non-supplemented children (Friell et al, 1993). There were no differences in mental development.

However, in two recent studies in Bangladesh, zinc supplementation given to undernourished children or pregnant women had a small detrimental effect on infant development. In the first study, infants were supplemented from 1 month to 6 months of age with 5mg of zinc and their development measured at 7 and 13 months. No differences were found at 7 months but at 13 months the children receiving placebo scored significantly higher than the zinc supplemented children on the Bayley mental scale (Hamadani et al, 2001). In the second study, pregnant women were supplemented from the 4th month of gestation until birth and the infants of the women receiving zinc supplementation scored significantly lower on both the Bayley mental and motor scales at 13 months than those in the zinc supplemented group (Hamadani et al, 2002). No significant effects of zinc supplementation were found in either study for behaviour or nutritional status. The authors suggested that the negative effect of zinc supplementation
on child development may be due to mono-nutrient supplementation interfering with the nutrient balance and increasing other micronutrient deficiencies by inhibiting absorption.

1.5.3. Conclusions
In summary, there is evidence that zinc supplementation benefits child growth but the evidence for the effect of zinc on child development and behaviour is contradictory. Two studies investigated the effect of zinc supplementation on child behaviour observed at home and both reported increases in child activity level. However, of three studies that rated child behaviour during a developmental test session only one found a significant benefit of zinc supplementation. Five studies measured motor development and one study showed benefits of zinc supplementation, three showed no difference between the groups, while in another the children receiving zinc showed a deficit. Four studies reported measures of mental development and there were no benefits of zinc supplementation in any study while in two, benefits were found for children in the placebo group. Therefore we can conclude that zinc supplementation has benefits in some populations but not others, and may even have a detrimental effect in others.
1.6. Early Childhood Education

Early childhood education (ECE) describes programmes operating for a period of time between birth and school entry which are designed to promote the development of young children. Meisels (1992) characterizes interventions as child-focused, parent-focused or joint-focused.

Child-focused programs are usually centre based and involve providing educational activities for groups of young children. Most centre based child-focused programs have catered for children aged three or over although there are some notable exceptions in which infants attended a centre from as early as 6 weeks to 3 months of age (for example, the Abecedarian project).

Parent-focused programs most commonly deliver services through home visiting. The majority of these programs cater for children less than 3 years of age (although again there are some exceptions, for example, the HIPPY program which involves showing mothers of 4 to 5 year old children educational activities to promote their child’s school readiness). The basic tenet underlying this approach is that changing the proximal environment of the child by improving parenting skills will indirectly lead to developmental gains for the child.

Some programs have a child and parent focus. These programs involve centre based education and care for children being complemented with home visits for parents. Programs involving the provision of early childhood education activities for undernourished children have been reviewed in the previous section.

This section will include the following:

- A short discussion of the effects of child-focused services on child development
- A detailed review of parent-focused programs for disadvantaged children
- A description of evaluations of early education programs in developing countries
A discussion on who benefits most from early intervention programs and the factors affecting program efficacy

A discussion on the efficacy of home visiting versus group sessions in improving child development and parenting.

1.6.1. Efficacy of Child-Focused Early Interventions

Barnett (1995) reviewed 36 studies of early childhood education (ECE) programs reporting effects on child IQ, school achievement and school success to at least age 8 years. Fifteen of these programs were specially designed research programs and twenty one were large-scale public programs. Thirty of these programs catered for children aged 3 or older and thirty four involved centre based educational activities for children. Hence the review is largely of centre based, child-focused programs for pre-school aged children.

All of the programs showed benefit of ECE to measures of child IQ at some point and for twelve out of the sixteen that measured IQ at school entry the benefit of ECE was maintained. However, for most programmes the intervention effect on IQ diminished on entering school. The benefit was largest for the only two randomized trials which enrolled infants in full day centre based services for the first five years of life (Campbell & Ramey, 1994; Garber, 1988).

The available data on school achievement are beset with measurement problems likely to minimize differences found between groups. Despite this, fifteen of the thirty two (47%) of the programs that measured school achievement beyond 8 years demonstrated effects and the effect was strongest for the studies which employed random assignment. Twenty five of the programmes reviewed reported the effect of ECE on rates of grade retention and placement in special education and twenty two (88%) showed a benefit of intervention. Five programmes reported results of high school graduation and all five found that more experimental children graduated than control children.
Barnett concluded that early childhood education:

"can produce large effects on IQ during the early childhood years and sizable persistent effects on achievement, grade retention, special education, high school graduation..."

Barnett, 1995 pg: 35

Haskins (1989) reports evidence from The Consortium for Longitudinal Studies which followed up children from 11 early education projects when they were 9-19 and 12-22 years old. 8/11 of these programs provided primarily centre based, child-focused services. 56% of the original sample was followed up and the data analysed for benefit to IQ, school achievement, rates of grade retention, special education and high school graduation. Early education projects were found to have a significant impact on placement in special education, grade retention, high school graduation, achievement in maths through to 5th grade and reading to 3rd grade.

The benefits of early childhood education on children's intellectual development and school progress have been investigated in many studies and much fewer studies have included behavioural and/or social outcomes. Yoshikawa (1995) reviewed the long term effects of early childhood interventions on delinquency and identified four programs which reported intervention effects on anti-social behaviour more than 5 years after the end of the program. All four showed positive effects for children receiving the intervention and all four involved a combination of a centre based, child-focused service with a home visiting, parent-focused component.

There has been little attempt to evaluate the effect of child-focused programs on maternal outcomes such as parenting, mental health or life course. Benasich et al (1992) reviewed studies of early childhood intervention programs for their effects on mothers and only four child-focused randomized controlled trials reported maternal outcomes. The results were mixed. Three reported on maternal employment and of these two found benefits to the intervention group. All four had measures of parenting quality (predominantly the Home Observations for Measurement of the Environment (HOME)
scale and maternal attitudes) and only one reported gains for the mothers of children receiving intervention.

1.6.2. Head Start

Head Start is a public preschool program for poor children operating on a large scale in the US and nearly a quarter of a million children were enrolled in Head Start programs in 1994. These programs are diverse but usually provide one or two years of part day, child-focused, centre based services for disadvantaged 3-5 year old children and nutrition health care are also provided as well as referral to social services for participating families. Evaluations of these programs give some indication of the effects that can be expected from universal early childhood education for poor children.

McKey et al (1985) reported results of a meta-analysis of 30 studies and found that attendance at Head Start produced immediate gains on IQ, school readiness and school achievement (effect sizes of .59, .31 and .54 respectively). However these gains were diminished after one year of schooling (effect size of .09 for IQ, .21 for school readiness and .20 for achievement) and after 3 years there was no longer any benefit found of attendance at Head Start (effect sizes of 0 for IQ and -.20 for achievement).

Seventeen studies also looked at social and emotional benefits from intervention. Similar to the above, immediate benefits were found for self esteem, achievement motivation and behaviour (effect sizes of .17, .22 and .35 respectively) but after 3 years of schooling there was no longer any evidence of a benefit from intervention. However, few studies controlled for initial differences between intervention and control groups and as Head Start caters for the most disadvantaged children in the community the gains attributable to Head Start may have been underestimated.

1.6.3. Summary of Centre Based Services

In summary, centre based services have been shown to produce immediate gains to child IQ but the differences between children with and without preschool experience are usually no longer significant after a number of years in school. This is usually due to the
scores of the control group increasing after entry into school rather than a reduction in IQ for children in the intervention group. However, long term benefits of intervention have been found for school achievement, school progress and high school graduation particularly for high quality interventions. Few studies have examined the long term effects of intervention on adult productivity and/or behaviour but there is some evidence that child-focused intervention in the early years can benefit the life course of participating children especially if combined with a family support intervention. There is little evidence of the benefits which mothers derive from child-focused services in terms of quality of parenting, maternal life course or psychosocial function. Centre based services have for the most part targeted children over 3 years of age. For children under 3 years of age, parent-focused interventions are more appropriate (Grantham-McGregor et al, 1999).
1.7. Review of Parent-Focused Interventions

Although there is a vast literature of early childhood education, there are few reviews of parent-focused interventions and few reviews which include the effect of intervention on maternal outcomes. Benasich et al (1992) reviewed experimental and quasi-experimental studies of child-focused and parent-focused interventions for both child and parent outcomes but that review is now 10 years old. Olds & Kitzman (1993) reviewed randomized controlled trials of home visiting interventions only and more recently, Brooks-Gunn et al (2000) reviewed studies which examined the effect of parent-focused interventions, operating during the 1st 3 years of life and of at least 6 months duration, on maternal outcomes only. There is thus no recent comprehensive review of the effects of parent-focused early interventions, operating during the first 6 years of life, on child and maternal outcomes. Therefore, this review was undertaken. Searches were conducted using Medline, Psychlit and ERIC databases and also by hand searching previous reviews for relevant studies. Studies were included if they satisfied the following criteria:

1. Random allocation to groups was employed.
2. There was an explicit focus on providing parent education to improve children’s general development.
3. There was a control group who did not receive the parent-focused intervention or who received a placebo.
4. The program targeted mothers at some point between the prenatal period and school entry.
5. The program targeted mothers in disadvantaged circumstances.

Hence interventions aimed at promoting secure attachment, reducing the incidence of child abuse and neglect and promoting good health and/or nutrition were excluded if there was no stated aim of also improving children’s overall development. Also, studies which compared the efficacy of one approach with another were excluded if there was no no-treatment control group. Programmes catering specifically for mothers of disabled children and mothers of preterm infants were also excluded from this review.
The programs varied greatly in the age of the children on enrolment, duration of the intervention and the intensity of the intervention. In addition, different strategies were used with the majority of the studies using home-visiting to deliver the program while others involved the mothers and children meeting in a centre. The content and comprehensiveness of the interventions provided also differed. Examples of content included showing the mother age appropriate activities to do with her child using materials brought to the home or items in the home, improving maternal-child interaction, providing information on nutrition and health care, counseling for personal problems, provision of social support, referral to community services for help when needed and providing assistance to the mother in terms of furthering education, family planning and gaining employment. Twenty six parent-focused interventions for disadvantaged children were reviewed. Details of the sample (age, risk factors, attrition), duration of the program, setting (home or centre), staffing, content of the intervention and the short term effects (up to 3 years post intervention) are given in table 1.4. The articles were reviewed for both child and maternal outcomes.

Child outcomes were categorized as:

1. **Child IQ**: measured by standardized scales
2. **Child behaviour**: includes observed behaviour, ratings by teachers and parents, self report and official records
3. **Schooling**: including school achievement, retention in grade, placement in special education and high school graduation
4. **Nutritional status**

Maternal outcomes were categorized as:

1. **Parenting**: which includes observed parent child interaction, parenting attitudes, parenting knowledge, parenting self-esteem or self-competence, parenting stress and the HOME
2. **Maternal life course**: education, employment, child bearing, receipt of welfare, criminality, drug and alcohol abuse
3. **Psychosocial function**: including depression, anxiety, self-esteem as well as stresses and buffers such as social support and chronic stressors.
1.7.1. Efficacy of Interventions with Disadvantaged Children

Twenty six randomized controlled trials of parent-focused early childhood intervention services were reviewed and the details of the sample, intervention and short term effects are summarized in table 1.4. Many of the studies had methodological weakness. Attrition was a problem in many of the studies and in some cases there was differential attrition between the experimental and control groups (Andrews et al, 1982; Baker et al, 1999). In addition, despite the randomization procedure, significant differences between the intervention and control groups were found at pre-test in some projects and it was not always clear the extent to which these differences were controlled for in the analysis (Infante-Rivard et al, 1989; Duggan et al, 1999). Further weaknesses lay in the blinding of the assessors. For example, in the HIPPY project (Baker et al, 1999), teacher’s evaluations of pupils were used but it is not stated whether teachers were aware of which children had received the intervention, while in the Community Mothers Programme (Johnson et al, 1993), the interviewers were not blind to the intervention status of the mothers. Furthermore, in one study (Field et al, 1982) test items were used in the activities for the children and hence positive results may be due to test practice rather than to an improvement in the child’s ability.

Despite these limitations, a review of these interventions helps to further our understanding of the effects of parent-focused interventions on children and their mothers and the factors affecting the results.

**Child IQ:**

Twenty four parent-focused programs had measures of child development and of these, thirteen showed benefits of intervention at immediate post test and/or after a follow up period of up to three years. These gains were largely found for children’s mental development and only one program found gains to child motor development (Field et al, 1982).

In addition, 4 of the 11 programs finding no benefit on tests of mental and motor development reported some benefit on other child developmental outcomes. Two programs reported significant differences on parent report scales of child development (Wagner & Clayton, 1999; Scarr & McCartney, 1988); one found a benefit on receptive
language (Gray and Ruttle, 1980) while Madden et al (1984) reported gains on a program achievement test.

In addition, some programs benefited certain subgroups only. For example, Olds et al (1986) found a difference of 10 IQ points favouring the intervention group for children of poor, unmarried, teenage mothers compared with similar children in the control group while children of Spanish speaking Latina mothers were the only group found to benefit in the Parents as Teachers (PAT) program (Wagner & Clayton, 1999). In the latter study, the remaining children in the sample scored 4 points lower than comparable children in the control group.

This suggestion of a potential detrimental effect of a home visiting programme was also found for Project Care (Wasik et al, 1990). In this project, children in a joint-focused program involving child centre based care combined with home visiting scored significantly higher on IQ than children in a home visiting program at 4 years of age but there were no significant differences between children receiving the centre based service and the controls. However, more children in the control group attended community day care.

The programs which were successful in promoting child development varied in the age of the children at the start of the intervention (from the prenatal period through to age 4 years) in the duration of the programme (from between 6 months to over 3 years), the intensity of the program (range from 24 stimulation visits over 3 years to weekly home visits) and staffing (paraprofessionals or professionals). A similar pattern is found for the programs which did not show cognitive gains for children in the intervention group. It is thus difficult to identify the factors which determine program success in facilitating child development.

Child Behaviour:

Only nine programs reported measures of child behaviour and of these five showed significant benefits of intervention (Klein & Alony, 1993; Andrews et al, 1982; Slaughter 1983; Gutelius et al, 1977; Field et al, 1982). Differences were more likely to be found in observations of child behaviours than in measures relying on maternal report.
**Schooling:**

Four programs reported measures of school achievement and three of these programs showed benefits of intervention (Baker et al, 1999; Gray et al, 1983; Jester & Guinagh, 1983). Two of these programs were targeted at preschool age children and were focused on improving school readiness while the third (Jester & Guinagh, 1983) was for children up to the age of 3 years. The Comprehensive Child Development Program (CCDP) (St Pierre & Layzer, 1999) showed no benefits to school achievement. However, the early childhood education component involved only 13 hours/year of home visits for the first three years followed by referral to community preschool programs of variable quality until age 5 years. Although no details are given it is likely that children from the control group attended the same or similar preschool programs.

**Nutritional status:**

Only one study reported on the nutritional status of the children and concurrent and sustained benefits were found to child weight from both a home visiting intervention and a nursery intervention from birth to six months compared to a no-treatment control group (Field et al, 1982).

**Parenting:**

Twenty one studies had some measures of parenting and of these 13 showed significant benefits on at least one of the measures. Benefits were found for parenting attitudes (Gutelius et al, 1977; Johnson et al, 1993); the home environment as measured by the HOME (Kitzman et al, 1997; Andrews et al, 1982; Gray & Ruttle, 1980); mother-child interaction (Olds et al, 1986; Andrews et al, 1982; Gray & Ruttle, 1980; Thompson et al, 1982; Klein & Alony, 1993) and for mothers report of time spent playing, singing or reading to their child (Johnson et al, 1993; Gutelius et al, 1977; Slaughter, 1983). A recent meta-analysis of 12 studies (Kendrick et al, 2000) showed that home visiting parenting programs produced a highly significant benefit on the quality of the home environment as measured by the HOME scale \(p = .001\).
Maternal Life Course:

Only five programs reported the effects of a parent-focused intervention on maternal life course and four of these showed significant results. Mothers receiving the intervention were more likely to attend school (Gutelius et al, 1972; Field et al, 1982), had fewer repeat pregnancies (Kitzman et al, 1997; Olds et al, 1999; Field et al, 1982) and were more likely to be employed (Olds et al, 1999; Field et al, 1982) than mothers in the control group. However, in the Comprehensive Child Development Program, no difference was found between the intervention and control groups in the number employed and in education or the number of repeat pregnancies (St Pierre & Layzer, 1999).

Psychosocial Function:

Four programs reported the effects of intervention on maternal depression and two showed a positive affect at at least one time point. In the Hawaii’s Healthy Start program differences favouring the intervention group were found at 1 year but not at 2 years (Duggan et al 1999). However, differences favouring the intervention group were also found at baseline and no indication is given if these differences were controlled for in the analysis. The Community mothers’ program (Johnson et al, 1993) did not use a standardized measure of depression but mothers in the intervention group reported being less tired, less miserable and a lesser desire to stay indoors than mothers in the control group which are symptoms of depression although the authors refer to the measure as self-esteem. Three programs reported self-esteem measures and two started in pregnancy or from birth and found a significant benefit of intervention (Kitzman et al, 1997; Duggan et al, 1999), while the other catered to mothers of toddlers and found no benefit (Slaughter, 1983). It is possible that the timing of the intervention influenced the contrasting results.
<table>
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<tr>
<th>Study</th>
<th>Sample</th>
<th>Intervention</th>
<th>Short term effects</th>
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<tr>
<td>USA (Infante-Rivard et al, 1989)</td>
<td>51 low SES pregnant women randomly assigned to intervention (E n = 21) or control (C n = 26)</td>
<td>Intervention from pregnancy to 30 weeks</td>
<td><strong>Child Outcomes</strong>&lt;br&gt;IQ: E = C on Bayley mental and motor at 15 months&lt;br&gt;&lt;br&gt;<strong>Maternal outcomes</strong>&lt;br&gt;Parenting: E = C on HOME at 9 months</td>
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<td>Mobile Unit for Child Health Supervision, USA (Gutelius et al, 1972, 1977)</td>
<td>92 first born black infants of low SES, teenaged, unmarried mothers randomly assigned to intervention (E n = 46) or control (C n = 46)</td>
<td>Intervention from &lt; 7 month of pregnancy to 3 years of age.&lt;br&gt;Intervention involved home visits for well baby care and early childhood stimulation.&lt;br&gt;The well baby care visits were conducted by a nurse and pediatrician in a mobile unit: 9 visits in 1st year, 7 visits in 2nd year and 5 visits in 3rd year.&lt;br&gt;The stimulation visits were conducted by a nurse: 10 visits in 1st year, 8 visits in 2nd year &amp; 6 visits in 3rd year. Mothers were shown activities to promote child development and a toy was given at each visit.&lt;br&gt;Counseling for personal issues was also provided.</td>
<td><strong>Child outcomes</strong>&lt;br&gt;IQ: E = C on Stanford Binet at 3 &amp; 4 years&lt;br&gt;Mental: E = C on HOME at 3 &amp; 4 years&lt;br&gt;<strong>Maternal outcomes</strong>&lt;br&gt;Parenting: E &gt; C on ratings of maternal warmth at 3 &amp; 4 years&lt;br&gt;E &gt; C on rating of maternal involvement at 3 yrs&lt;br&gt;E = C on HOME at 3 &amp; 4 years&lt;br&gt;<strong>Maternal life course:</strong> E &gt; C on # employed during 4 year of life&lt;br&gt;E &lt; C on # of subsequent pregnancies during 4 years</td>
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<td>Elmira, New York (Olds et al, 1986, 1988,1994, 1997, 1999)</td>
<td>Low income, unmarried pregnant women randomized to 4 groups. For the outcomes reported here analysed as 2 groups: intervention (n = 116) &amp; control (C n = 148)</td>
<td>Intervention began prenatally until age 2 years.&lt;br&gt;Intervention as below for the trial in Memphis.&lt;br&gt;Visit weekly for the 1st month, fortnightly until the birth, weekly for 6 weeks, twice a month to 21 months &amp; once a month to 24 months.&lt;br&gt;Implementation:&lt;br&gt;Mean # visits: 9 prenatally &amp; 23 postnatally</td>
<td><strong>Child outcomes</strong>&lt;br&gt;IQ: E = C on Bayley mental &amp; motor at 2 years&lt;br&gt;E = C on Stanford Binet at 3 &amp; 4 years&lt;br&gt;<strong>Maternal outcomes</strong>&lt;br&gt;Parenting: E = C on ratings of maternal warmth at 3 &amp; 4 years&lt;br&gt;E &gt; C on rating of maternal involvement at 3 yrs&lt;br&gt;E = C on HOME at 3 &amp; 4 years&lt;br&gt;<strong>Maternal life course:</strong> E &gt; C on # employed during 1st 4 year of life&lt;br&gt;E &lt; C on # of subsequent pregnancies during 1st 4 years</td>
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Table 1.4. Details of the Sample, Intervention and Short Term Effects of Early Childhood Interventions with Disadvantaged Children

<table>
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<tr>
<th>Study</th>
<th>Sample</th>
<th>Intervention</th>
<th>Short term effects</th>
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</thead>
</table>
| Memphis        | Black, low SES, unmarried women < 29 weeks pregnant randomized to 4 groups. For outcomes reported here analysed as 2 groups: intervention (E n =224) and control (C n = 511) | Intervention began prenataingly until age 2 years. Intervention involved home visits by nurses during pregnancy which continued through until the child's 2nd birthday. Nurses focused on physical health & diet during the prenatal visits. Postnataally the home visits focused around improving the child care environment (health, mother-child interaction, safety in the home, play) and provided counseling and help with problem solving. | *Child outcomes at 2 years*  
IQ:  
E = C on Bayley mental  
*Behaviour:*  
E = C on Child behaviour checklist  
*Maternal outcomes at 2 years*  
*Parenting:*  
E > C on HOME  
E = C on observed teaching behaviour  
*Maternal life course:*  
E > C less repeated pregnancies  
E = C on education, employment & # on welfare  
*Psychosocial function:*  
E = C on maternal anxiety and depression  
E > C on mastery (self-efficacy) |
| USA, (Field et al, 1982) | 120 black, low SES, teenage mothers and their infants randomized to:  
E1: home visiting (n = 40)  
E2: nursery intervention program (n = 40)  
C: control (n = 40) | Intervention from birth to 6 months.  
*Home visiting:*  
Fortnightly visits from a psychology graduate and black female student for 6 months. 6 activities to be done with the child every day for 5 minutes each were demonstrated to the mothers. Toys were also given.  
*Nursery intervention:*  
Mothers were provided with employment training to be a teacher's aide in an infant nursery which their own infant also attended for 4 hrs/day 5 days/week. | *Child outcomes*  
IQ:  
E1 & E2 > C on Denver at 4 months & Bayley motor at 8 months and 1 year.  
E2 > E1 > C on Bayley mental at 1 yr & 2 yrs and on Bayley motor at 2 years.  
*Growth:*  
E1 & E2 > C on weight at 4 months, 8 months, 1 yr & 2 yrs  
*Behaviour:*  
Infants in the E2 group averted their gaze less in mother child interaction at 4 months  
E1 & E2 rated as being less difficult on a temperament questionnaire at 4 months. Difference only significant for E2 at 8 months.  
*Maternal outcomes*  
*Maternal life course:*  
E2 > E1 > C on # mothers returning to school or work at 1 & 2 years.  
E2 < E1 < C on # mothers with repeat pregnancies at 1 & 2 years |
### Table 1.4. Details of the Sample, Intervention and Short Term Effects of Early Childhood Interventions with Disadvantaged Children

<table>
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<th>Study</th>
<th>Sample</th>
<th>Intervention</th>
<th>Short term effects</th>
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<tbody>
<tr>
<td>Menninger infant project</td>
<td>120 13-17 year old mothers and their infants randomly assigned to intervention (E) or control (C)</td>
<td>Intervention from birth to 30 months</td>
<td>Child outcomes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intervention involved home visits by paraprofessionals: weekly for the 1st month and monthly from 1 to 30 months. Home visits focused on parent education, demonstrating activities and counseling for mother’s personal problems.</td>
<td><strong>IQ:</strong></td>
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<tr>
<td></td>
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<td></td>
<td>E = C on Bayley mental at 24 &amp; 36 months</td>
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<td><strong>Parenting:</strong></td>
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<td>E = C on maternal child interaction during feeding and during play at 20 &amp; 36 months</td>
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<td></td>
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<td>E = C on HOME at 36 months</td>
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<td>E = C on depression, self-esteem, social support &amp; stress at 20 months</td>
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<td>E &gt; C on reading to child, playing cognitive games, singing nursery rhymes and having more positive and less negative feelings about their child</td>
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<td>E group less tired, less miserable and less desire to stay indoors than C group</td>
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<td>E = C on # headaches</td>
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<tr>
<td>Community Mothers Programme, Dublin (Johnson et al, 1993)</td>
<td>262 first time, low SES mothers randomized to intervention (E n = 141) or control (C n = 121)</td>
<td>Intervention from birth to age 1 year</td>
<td>Child outcomes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intervention involved monthly home visits by volunteer mothers. Focus on promoting reading to child, language development and play. Intervention involved sharing experiences rather than giving advice.</td>
<td><strong>IQ:</strong></td>
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<td></td>
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<td>E &gt; C on reading to child, playing cognitive games, singing nursery rhymes and having more positive and less negative feelings about their child</td>
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<td>E &lt; C on HOME at 36 months</td>
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<tr>
<td>USA (Thompson et al, 1982)</td>
<td>40 black, unmarried, low SES teenage women randomly assigned to intervention (E n = 20) or control (C n = 20)</td>
<td>Intervention from birth to 2 years</td>
<td>Child outcomes</td>
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<tr>
<td></td>
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<td>Intervention involved monthly home visits by nurses. Mothers were shown developmentally appropriate activities to do with their child to stimulate development in all areas.</td>
<td><strong>IQ:</strong></td>
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<td>E &gt; C at 18 months on Bayley scales</td>
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<td></td>
<td>E &gt; C at 30 months on Stanford Binet – 8.5 IQ points difference (p &lt; .1)</td>
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<td>E &lt; C on % of children with IQ &lt; 85 at 30 months (50% of C vs. 11% of E)</td>
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</tbody>
</table>
Table 1.4. Details of the Sample, Intervention and Short Term Effects of Early Childhood Interventions with Disadvantaged Children

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample</th>
<th>Intervention</th>
<th>Short term effects</th>
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</thead>
<tbody>
<tr>
<td>Hawaii’s Healthy Start Program, Hawaii (Duggan et al, 1999)</td>
<td>643 ‘at risk’ families across 3 sites randomized to intervention (E n = 373) or control (C n = 270) 88% followed up</td>
<td>Intervention from birth to 2 years  Intervention involved home visits by paraprofessionals which focused on parent education, modeling of parent-child interaction, health care and referrals to social services. The number of visits varied according to the needs of the family. <strong>Implementation:</strong> 51% of families no longer involved in program after 12 months Mean # visits: 13 in 1st year for all families; 22 in 1st year for families still involved after 1 year of service.</td>
<td><strong>Child outcomes</strong>  IQ:  E = C on Bayley mental &amp; motor after 1 &amp; 2 yrs  <strong>Maternal outcomes:</strong>  <strong>Parenting:</strong>  E = C on home learning environment, mother-child interaction, parenting stress levels  E &gt; C on parenting self-efficacy at 2 yrs  <strong>Psychosocial function:</strong>  E &lt; C on frequency of depressive symptoms at 1 year  E = C on depressive symptoms at 2 yrs</td>
</tr>
<tr>
<td>Project CARE, USA (Wasik et al, 1990)</td>
<td>65 families classified as ‘high risk’ randomized to;  E1: child development centre &amp; family education (n = 16)  E2: family education only (n = 25)  C: control (n = 23)  91% followed up</td>
<td>Intervention from birth to age 5 years.  <strong>Child development centres:</strong> Available from 7.30 until 5.30 5 days/week. Children entered the centre aged between 6 weeks &amp; 3 months. Staffing ratios of 1:3 for infants, 1:4 for 2 year olds and 1:6 for 3-5 year olds.  <strong>Family Education:</strong> involved home visits by professionals (social workers, day care teachers, nurses) weekly for the 1st 3 years and according to the families need in years 4 &amp; 5. Focused on child stimulation and problem solving for parents.  <strong>Parent groups:</strong> held monthly for E1 &amp; E2. <strong>Implementation:</strong>  Mean # visits in 1st 3 years: 2.7/mth for E1 &amp; 2.5/mth for E2  Mean # visits in years 4 &amp; 5: 1.1/mth for E1 &amp; 1.4/mth for E2</td>
<td><strong>Child outcomes</strong>  IQ:  E1 = E2 = C on Bayley mental &amp; motor at 6 months  E1 &gt; C = E2 on Bayley mental at 12 &amp; 18 months and on Stanford Binet at 24 &amp; 36 months  E1 = C &gt; E2 on Stanford Binet at 48 months and on the McCarthy Scales at 30, 42 &amp; 54 months.  <strong>Maternal outcomes</strong>  <strong>Parenting:</strong>  E1 = E2 = C on HOME  E1 = E2 = C on parenting attitudes</td>
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</table>
Table 1.4. Details of the Sample, Intervention and Short Term Effects of Early Childhood Interventions with Disadvantaged Children

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<thead>
<tr>
<th>Study</th>
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<th>Intervention</th>
<th>Short term effects</th>
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</thead>
<tbody>
<tr>
<td>Comprehensive Child Development Program,</td>
<td>4,410 disadvantaged families</td>
<td>Intervention from birth – 12 months to 5 years.</td>
<td>Child Outcomes</td>
</tr>
<tr>
<td>USA (St Pierre &amp; Layzer, 1999)</td>
<td>across 21 project sites</td>
<td>A two generation programme which combines services for children with services for adults. Aimed to enhance child development, support parents and increase economic productivity of parents. Works largely through case management and families are referred to relevant agencies in the community.</td>
<td>IQ: E = C on Kaufman mental processing scale and PPVT</td>
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<td></td>
<td>randomly assigned to intervention (E n = 2213) or control (C n = 2197)</td>
<td>The early childhood education component: involved home visits for the 1st 3 years and either community centre based services or home visits at age 4 &amp; 5 years. Home visits were fortnightly for 30 minutes and focused on parent education.</td>
<td>School Achievement: E = C on Kaufman achievement scale</td>
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<td>76% followed up at 5 years.</td>
<td>Implementation: 58% participated in the program for &gt; 3 years, 48% for &gt; 4 years and 33% for &gt; 5 years</td>
<td>Behaviour: E = C on child behaviour checklist &amp; adaptive social behaviour inventory.</td>
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<td>Maternal outcomes</td>
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<td></td>
<td>Parenting: E = C on parenting attitudes, HOME and parent-child interaction (observation).</td>
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<td>Maternal life course: E = C on employment, income, % on welfare assistance, education, &amp; child bearing.</td>
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<tr>
<td>The Gordon Parent Education Infant and Toddler Program, Florida (Jester &amp; Guinagh, 1983)</td>
<td>278 low SES families randomly assigned to intervention (E n = 171) or control (C n = 109)</td>
<td>Intervention from 3 months to 3 years. However, the study was designed to compare different timing and intensities of early education and children in the intervention group received 2 or 3 years of intervention.</td>
<td>Child Outcomes</td>
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<tr>
<td></td>
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<td>Intervention involved weekly home visits by paraprofessionals in which mothers were shown activities to do with their child using materials found in the home.</td>
<td>IQ: E = C at age 1 and 2 yrs on Griffiths &amp; Bayley scales</td>
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<td>At age 2 the children also attended a home learning centre for 2 hours, 2 days a week in which groups of 5 children were gathered by a paraprofessional for 'nursery school' type experiences.</td>
<td>E &gt; C at age 3, 4, 5 &amp; 6 on Stanford Binet</td>
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<td>Schooling: E &gt; C on reading and maths at age 6</td>
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<td>Maternal outcomes</td>
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<td>Parenting: E &gt; C on home environment review</td>
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<td>Life course: E &lt; C on repeat pregnancies</td>
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<td>Psychosocial function: E more internal locus of control</td>
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</tbody>
</table>
Table 1.4. Details of the Sample, Intervention and Short Term Effects of Early Childhood Interventions with Disadvantaged Children

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample</th>
<th>Intervention</th>
<th>Short term effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parents as Teachers Program (PAT), USA (Wagner &amp; Clayton, 1999)</td>
<td>2 randomised trials.</td>
<td>Intervention from ≤ 6 months of age until age 2 years for Teen Pat and age 3 years for Salinas Valley.</td>
<td>Child outcomes at end evaluation</td>
</tr>
<tr>
<td>Salinas Valley: Families randomized to intervention (E n = 298) or control (C n = 199) 73% followed up</td>
<td>Involved home visits by a paraprofessional once a month for 2 – 3 years. Mothers were shown activities and games to stimulate child development using material brought by the home educators.</td>
<td>IQ: E &gt; C on cognitive, self-help &amp; social development scales of the Development Profile II (DPII) in Salinas Valley (1.5, 2.3 &amp; 2.4 months benefit respectively. (N.B. the DPII is a parent report scale). E = C on Bayley motor &amp; mental, communication scale of DPII and PPVT in Salinas Valley E1 = E2 = C1 = C2 on social, self-help &amp; communication scales of DPII in Teen PAT E2 &amp; C1 &gt; E1 &amp; C2 (1.3 months benefit)</td>
<td></td>
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<tr>
<td>Teen Pat – 4 sites Mothers &lt; 19 years of age randomized to 4 groups E1: PAT only (n = 177) E2: PAT &amp; case management (n = 175) C1: case management only (n = 174) C2: control (n = 178) 52 followed up</td>
<td>Case Management: mothers were referred to community services as required. Implementation Salinas Valley: 43% of families dropped out of the intervention Mean # home visits over 3 years = 20</td>
<td>Maternal outcomes at end evaluation Parenting: E = C on parenting knowledge and attitudes &amp; HOME in Salinas valley E1 = E2 = C1 = C2 on parenting knowledge and attitudes &amp; HOME in teen PAT.</td>
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</tr>
<tr>
<td>Israel (Klein &amp; Alony, 1993)</td>
<td>68 low SES families randomly assigned to intervention (E n = 48) or control (C n = 20)</td>
<td>Intervention involved weekly home visits by a paraprofessional who showed the mother teaching behaviours (named ‘mediating behaviours’ and including focusing, affecting, expanding, regulating &amp; encouraging)</td>
<td>Child outcomes at age 4</td>
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<td></td>
<td>Control group received a placebo of weekly home visits by a paraprofessional in which they were given information on child development appropriate to their child’s age and given help in planning the child’s environment to provide learning opportunities.</td>
<td>IQ: E &gt; C on PPVT E &gt; C on verbal reasoning Behaviour: E &gt; C on naming and associating E &gt; C on requesting and providing expansions for girls only Maternal outcomes Parenting: E &gt; C on focusing, affecting, expanding &amp; encouraging 1 and 3 years after intervention E = C on regulating 1 &amp; 3 years after intervention</td>
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</tbody>
</table>
Table 1.4. Details of the Sample, Intervention and Short Term Effects of Early Childhood Interventions with Disadvantaged Children

<table>
<thead>
<tr>
<th>Study</th>
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<th>Short term effects</th>
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</table>
| Canada, (Larson, 1980)        | 80 low SES, pregnant women randomly assigned to intervention (E n = 40) or control (C n = 40). | From 6 weeks to 15 months. Intervention involved 10 home visits by psychology graduates who gave advice on general child care, mother child interaction, child development and provided support in interpersonal relationships. | Maternal outcomes  
**Parenting:**  
E = C on HOME at 6 weeks, 6 months, 12 months & 18 months  
E = C on maternal behaviour (observed) at 6 weeks & 6, 12 & 18 months.  
| Birmingham Parent Child Development Centre (PCDC) (Andrews et al, 1982) | 251 low income, black families randomized to intervention (E n = 162) or control (C n = 89).  
44% of E group & 73% C group followed up | Intervention from 3-5 months until age 3 years. Intervention involved a centre based service for the mother and child together. The mother is shown how to interact and play with her child. By the 3rd year the mother teaches other mothers. Parent education and adult education lessons were also provided. Enrolment to 11 months: 12 hrs/week  
12 – 17 months: 20 hrs/week  
18-36 months: 40 hrs/week | No program effects on mother or child < 24 months.  
**Child outcomes**  
IQ:  
E > C on Stanford Binet at 36 & 48 months (8 points & 5 points respectively)  
**Behaviour:**  
E = C on touching, playing & talking with mother at 24 months and looking, smiling & talking to mother at 36 months  
**Maternal outcomes**  
**Parenting:**  
E > C on praising child, less use of restrictive language at 24 & 36 months  
E > C on providing information, participating in child game & holding child more at 36 months  
E > C on maternal teaching behaviours at 36 & 48 months |
| New Orleans PCDC (Andrews et al, 1982) | 126 black, low income families randomly assigned to intervention (E n = 67) or control (C n = 59).  
50% of E group & 75% of C group followed up | Intervention from 2 months until age 3 years. Intervention involved a centre based service for 2 mornings a week.  
1 morning / week on parent education  
1 morning / week on adult education  
Also had evening meetings for 4 hours/month | Child outcomes  
IQ:  
E = C on Uzgiris-Hunt, Bayley & Pacific Test from 2 to 24 months  
E > C on Pacific Test & Stanford Binet at 36 months & Stanford Binet at 48 months – 13 pts  
E = C on vocabulary test at 36 months  
**Maternal outcomes**  
**Parenting:**  
E > C on maternal sensitivity, acceptance & cooperation at 24 & 36 months  
E > C on use of positive language and positive teaching techniques at 36 mths (not at 24 mths)  
E > C on 2/12 mother child interaction variables at 48 months (less negative language and more positive teaching techniques) |
### Table 1.4. Details of the Sample, Intervention and Short Term Effects of Early Childhood Interventions with Disadvantaged Children

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample</th>
<th>Intervention</th>
<th>Short term effects</th>
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</table>
| **Ypsilanti-Carnegie Infant Education Project (Lambie et al., 1974)** | 88 low SES mothers & their infants randomized to E1: professional home visits (n = 31) E2: paraprofessional home visits (n = 30) C: control – no home visits (n = 27) | Intervention from 3-11mths for 16 months E1: weekly home visits by a professional teacher using structured curriculum with mother & child E2: weekly home visits by paraprofessional in an informal, non-structured format | Child outcomes  
IQ:  
E1 > E2 = C at post test on Bayley mental  
E1 = E2 = C on Bayley motor at post-test  
E1 = E2 = C at 1 year follow up on Bayley mental & motor  
Maternal outcomes  
Parenting:  
E1 > E2 = C on positive and supportive maternal interactions |
| **Houston PCDC (Andrews et al., 1982; Johnson & Walker, 1991)** | 216 Mexican American families randomized to intervention (E n = 97) or control (C n = 119) 50% of sample followed up | Intervention from 12 months to age 3 years  
Year 1: weekly home visits by for 30 weeks / year paraprofessional. Focused on parent education and activities with toys & books.  
Year 2: centre based service for 12 hrs/week focusing on home management & parent education  
Parent groups in the evening for 4 hrs/month | Child outcomes  
IQ:  
E > C on Bayley mental at 24 months  
C > E on verbal communication at 24 months  
E = C on Stanford Binet & verbal communication at 36 months  
Maternal outcomes  
Parenting:  
E = C on maternal interaction & HOME at 24 months  
E > C on maternal interaction at 36 months (talked more, elaborated on vocalizations more, showed less criticism and more encouragement of child’s verbalizations)  
E > C on HOME at 36 months |
| **The Family Oriented Home Visiting Program (Gray & Ruttle, 1980)** | 47 low SES families randomly assigned in 3 waves to intervention (E n = 27) or control (C n = 20) 78% followed up (74% E & 85% C) | Intervention from 17-24 months for nine months.  
Intervention involved weekly home visits by professionals and paraprofessionals which focused on building the mother’s self-esteem and improving her teaching style, behaviour management techniques, verbal interaction with her child and the quality of the home environment. Inexpensive or home made toys were used.  
**Implementation:**  
Mean # visits = 30 | Child outcomes  
IQ:  
E = C on Stanford Binet, at immediate post-test and 1 & 2 year follow up  
E > C on receptive language test at immediate post test (not tested at follow up periods)  
Maternal outcomes  
Parenting:  
E = C on HOME at immediate post-test and 1 year follow up  
E > C on HOME at 2 year follow up  
E > C on teaching strategies at 1 & 2 year follow up (but not significantly different at immediate post test) |
Table 1.4. Details of the Sample, Intervention and Short Term Effects of Early Childhood Interventions with Disadvantaged Children

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample</th>
<th>Intervention</th>
<th>Child outcomes</th>
<th>Short term effects</th>
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<tbody>
<tr>
<td>Mother-Child Home Program,</td>
<td>4 cohorts of 234 low SES families randomly assigned to intervention or control 61%, 86%, 57% &amp; 77% followed up in cohort 1, 2, 3 &amp; 4</td>
<td>Intervention from 21-33 months for 2 years</td>
<td>IQ:</td>
<td>E = C on Cattel infant development scales &amp; PPVT</td>
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<td>USA (Madden et al, 1984)</td>
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<td>Intervention involved twice weekly home visits by paraprofessionals for 10 months/yr for 2 years (46 visits/year). Home visits involved promoting verbal interaction using a toy or book brought to the home. Mean # visits: 40.3-43 in yr 1 &amp; 15.7-34.8 in yr 2</td>
<td>E &gt; C on program achievement test</td>
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<td>Maternal outcomes</td>
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<td>Parenting:</td>
<td>E &gt; C on maternal interactive behaviour (observed)</td>
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<tr>
<td>Mother-Child Home Program,</td>
<td>125 families (from low &amp; high SES stratum) in 4 cohorts randomly assigned to intervention (E n = 80) or control (C n = 45)</td>
<td>Children enrolled at age 24 – 30 months for 2 years.</td>
<td>Child Outcomes:</td>
<td></td>
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<tr>
<td>Bermuda (Scarr &amp; McCartney,</td>
<td>94% followed up</td>
<td>Intervention involved 46 twice weekly home visits by paraprofessionals for 10 months / year for 2 years. Focused on promoting verbal interaction using a toy or book brought by the visitor each week. Implementation &gt; 97.5% of visits conducted in both year 1 &amp; year 2.</td>
<td>IQ:</td>
<td>E = C on Stanford Binet, achievement test designed to test items taught in the curriculum</td>
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<td>1988)</td>
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<td>E &gt; C on sorting task taught by mother</td>
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<td>E &gt; C on communication skills (maternal report)</td>
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<td>Behaviour:</td>
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<td>E = C on childhood personality scale and Bayley infant behaviour record</td>
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<td>2/17 child outcomes significantly favoured E</td>
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<tr>
<td>Chicago, USA (Slaughter,</td>
<td>132 black, low income mothers randomized to E1: toy demonstration (n = 41)</td>
<td>From 18 to 44 months for 2 years</td>
<td>Maternal outcomes</td>
<td></td>
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<tr>
<td>1983)</td>
<td>E2: mother’s discussion group (n = 53) C: toys only (n = 38)</td>
<td>Toy demonstration: involved twice weekly home visits for 2 years. A toy or book is used each week to promote verbal interaction between mother and child. Mother’s discussion group: involved weekly 2 hour meetings for 2 years. Mothers met in groups of 10. The children were kept separately in another room throughout the meeting.</td>
<td>Parenting:</td>
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<td>Implementation:</td>
<td>E = C on teaching skills, discipline strategies, parenting self-esteem &amp; parenting attitudes.</td>
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<td>1st third of year 1: median group attendance = 53%</td>
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<td>1st third of year 2: median group attendance = 73%</td>
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Table 1.4. Details of the Sample, Intervention and Short Term Effects of Early Childhood Interventions with Disadvantaged Children

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample</th>
<th>Intervention</th>
<th>Short term effects</th>
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</table>
| Kingston, Jamaica (Powell & Grantham-Mcgregor, 1989) | 58 low SES mothers and their children randomized to intervention (C n = 29) or control (C n = 29) | Intervention from 16 – 30 months of age for 1 year Intervention involved weekly home visits by community health aides during which the mothers were shown activities to do with their child and a home made toy or a book was left in the home. | Child Outcomes  
IQ:  
E > C on Griffiths test at end evaluation  
E > C on PPVT at end evaluation |
| HIPPY, New York, USA (Baker et al, 1999)    | 2 cohorts of children randomly assigned:  
Cohort 1: intervention (E n = 52), control (C n = 70)  
Cohort 2: intervention (E n = 32), control (C n = 87)  
Only 71% of E group and 100% of C group followed up in 1st cohort.  
67% E & 76% C followed up in 2nd cohort | Intervention for 4 & 5 year olds for 2 years.  
Both intervention and control attended full day preschool / kindergarten for the 2 years of the project.  
**Intervention:**  
*Home visits:* fortnightly home visits by paraprofessionals for 30 weeks / year for 2 years. Books and activity packs used to promote school readiness in the child. Activities role played with parents who are expected to teach their children for 15 minutes /day.  
**Parent group meetings:** fortnightly parent group meetings for 30 weeks / year for 2 years. | Child Outcomes  
IQ:  
Cohort 1:  
E > C on Cooperative Preschool Inventory (CPI) (.63 SD) at end of program  
Cohort 2:  
E = C on CPI  
School achievement:  
Cohort 1:  
E = C on reading and maths at end of program  
E > C on reading at 1 year follow up (.75SD) but no significant difference on maths  
E > C on classroom adaptation at end of program and at 1 year follow up (.69SD & .68SD respectively)  
Cohort 2:  
E = C on reading and maths at end of program and 1 year follow up |
| The Early Training Project, USA (Gray et al, 1983) | 63 children randomized to:  
E1: summer schools & home visiting for 3 yrs  
E2: summer schools & home visiting for 2 yrs  
C: control | Intervention from 3.5-4.5 years for 2-3 years.  
Summer school: 10 week long centre based service 5 days/week. Staff-child ratio of 1:4  
Home visits: weekly home visits by paraprofessionals changing to monthly when child enters 1st grade. Focus on showing mother how to teach her child with materials provided. | Child outcomes  
IQ:  
E > C on Stanford Binet during the project, at immediate post-test and 1 year follow up  
School achievement:  
E > C on word knowledge, word discrimination and reading at 1 year follow up  
Behaviour:  
E = C on self-concept |
1.7.2. Long term Outcomes of Parent-Focused ECE Interventions

Only six of the parent-focused interventions discussed in the previous section had a long-term follow-up and these are summarised in table 1.5. Two of these studies had attrition rates of more than 70% (Johnson et al, 2000; Jester & Guinagh, 1983) and hence the validity of the study is compromised. These studies will not be discussed further. Only two programs had measures of child IQ at follow up and one of these reported benefits at age 6-7 years but not at age 13-14 years (Gray et al, 1983). One out of three programs that measured school achievement found benefits (Johnson & Walker, 1991) but the data was extracted from school records and hence is open to bias. Three reported on school progress and no differences were found on rates of retention in grade in any program (Johnson & Walker, 1991; Madden et al, 1984; Gray et al, 1983) and in only one was there a significant reduction in the number of children placed in special education (Gray et al, 1983). Olds et al (1997, 1999) found marked differences in maternal life course for the poor unmarried women in the sample in a 15 year follow-up study. These women had fewer subsequent pregnancies, fewer months on welfare, less drug and alcohol abuse and fewer convictions.

1.7.3. Summary of Parent-Focused Interventions for Disadvantaged Children

In summary, parent-focused interventions for disadvantaged children can produce significant benefits in the short term to child IQ, behaviour and school achievement although the gains are generally not so impressive and the results more mixed than for child-focused programs. Benefits to maternal parenting ability and maternal life course have also been reported. Few studies have examined the effect of parent-focused intervention on mother’s mental health and the results are contradictory. There are insufficient studies with a long term follow-up to make conclusions of the long term effects of parent-focused intervention on child and maternal outcomes.
### Table 1.5. Long Term Effects of Early Childhood Interventions with Disadvantaged Children

<table>
<thead>
<tr>
<th>Study</th>
<th>Longitudinal Effects</th>
</tr>
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</table>
**Parenting:**
E < C on verified case of child abuse during 15 years of child’s life  
**Life course:**
For poor, unmarried women only  
E < C subsequent pregnancies, on maternal report of # of months on welfare and of alcohol/drug abuse and on convictions & days in jail (from records) |
| **Community Mothers Programme, Dublin (Johnson et al, 1993, 2000)** | **Maternal outcomes at 7 years**  
**Parenting:**
E = C on reading to child  
E > C on visiting library weekly, checking homework nightly & disagreeing with punitive punishment  
**Psychosocial function**
E = C on tiredness, feeling miserable, desire to stay indoors & headaches  
E = C on Rosenberg self-esteem scale |
| **Houston PCDC (Andrews et al, 1982; Johnson & Walker, 1991)** | **Child outcomes at age 8-11 yrs**  
**Schooling:**
E > C on language, vocabulary & reading  
E = C on maths  
E = C on retention in grade (16% E & 29% C) and placement in special education (27% E & 31% C)  
**Behaviour:**
Children in C group reported as showing more hostility on teacher report scale |
| **Mother-Child Home Program, USA (Madden et al, 1984)** | **Child outcomes at 3 year follow up**  
**IQ:**
E = C on Stanford Binet  
**Schooling:**
E = C on reading & maths (Wide Range Achievement test)  
E = C on grade retention and placement in special education  
**Behaviour:**
E = C on teacher rating of behaviour  
**Maternal outcomes at 3 year follow up**  
**Parenting:**
E = C on maternal interactive behaviour |
| **The Early Training Project, USA (Gray et al, 1983)** | **Child outcomes**  
**IQ:**
E1 & E2 > C on WISC-R at 3 year follow up  
E1 = E2 = C on WISC-R at 10 year follow up  
**Schooling:**
E = E2 = C at 10 year follow up  
E < C in # placed in special education  
E = C in retention in grade and # graduating from high school  
**Behaviour:**
E = C in # teenage pregnancies but more pregnant girls in E group completed high school  
E = C on self-esteem |
| **The Gordon Parent Education Infant and Toddler Program, Florida (Jester & Guinagh, 1983)** | **Child outcomes**  
**IQ:**
E > C on WISC-R at age 10  
**Schooling:**
E > C on vocabulary and maths at age 10  
E = C on reading  
E < C on placement in special education  
**Behaviour:**
E = C on classroom behaviour inventory at 8 years & self-concept at 6 & 10 years  
**Maternal outcomes:**  
**Parenting:**
E = C on home environment review  
**Psychosocial function:**
E = C on self-concept and locus of control |
| **19% followed up** | |
1.7.4. Other studies with measures of maternal depression

As few of the studies included in the review examined the effects of a parent-focused intervention on maternal depression, six more randomized controlled trials were reviewed which examined maternal mental health as an outcome. Three studies for preterm low birth weight infants, two studies aimed at reducing child abuse and neglect and one aimed at improving child attachment were identified. These programs are summarized in table 1.6. The Infant Health and Development Program (IHDP) (1990) had a joint parent and child focus but it was included because the intervention was parent-focused for the first year.

All six studies began during pregnancy or from birth and three found significant benefits of intervention on maternal mental health (Klebanov et al, 2001; Armstrong et al, 2000; Erikson et al, 1992). However, Armstrong et al (2000) found a benefit at 6 weeks only and not at 4 months even though the intervention was still ongoing. Hence the gains were transient and the functional significance is questionable.

1.7.5. Summary of the Effects of ECE Interventions on Maternal Depression

All ten of the programs that reported on maternal depression started during pregnancy or soon after the birth of the infant. The results are mixed. Only five studies reported significant benefits of intervention on maternal depression. However, in one of these projects the interviewers were not blind to the mother’s treatment status and depression was measured by four isolated questions – only three of which were significantly different between the groups (Johnson et al, 1993), in one it is unclear if initial differences between the groups were controlled (Duggan et al, 1999) and in one the gains were short-lived (Armstrong et al, 2000). Hence there is no clear evidence that parent-focused early childhood interventions can help to alleviate maternal depressive symptoms.
Table 1.6. Details of parent-focused early childhood interventions which examine the effect of intervention on maternal mental health

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample</th>
<th>Intervention</th>
<th>Short term effects</th>
<th>Longitudinal Effects</th>
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<tbody>
<tr>
<td>Mother infant transaction program, USA (Rauh et al, 1988; Nurcombe et al, 1984; Achenbach et al, 1990, 1993)</td>
<td>78 low birthweight (&lt;2,250g), preterm (gestational age &lt; 37 weeks) infants spending ≥10 days in intensive care randomized at birth to intervention (E n = 38) or control (C n = 40)</td>
<td>Intervention from birth to 90 days.</td>
<td>Child outcomes: IQ: E = C at 6, 12 &amp; 24 months on the Bayley scales of mental development.</td>
<td>Maternal outcomes: Parenting: E &gt; C on maternal self-confidence and satisfaction in mothering role at 6 months. Psychosocial function: E = C on maternal depression and anxiety at hospital discharge and at 4 months.</td>
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<td></td>
<td>67% followed up at age 4 yrs (66%E &amp; 70%C) 72% followed up at age 7 yrs (63%E &amp; 80%C) 70.5% followed up at age 9 yrs (63%E &amp; 77.5% C)</td>
<td>A neonatal intensive care nurse conducted 11 one hour sessions with the mother and infant (7 in hospital and 4 at home at 3, 14, 30 and 90 days)</td>
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<td>Sessions involved increasing the sensitivity and responsivity of the mother to her infant.</td>
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<tr>
<td>USA (Finello et al, 1998, 1998b)</td>
<td>81 very low birthweight (750-1759g) from high risk families randomized to: HV = home visiting (n = 20) HH = home health care (n = 21) HV/HH (n = 20) C = control (n = 20) 78% followed up to 12 months</td>
<td>Intervention from birth to 1 year.</td>
<td>Child outcomes: IQ: E &gt; C at 36 &amp; 48 months on the McCarthy Scales of children’s abilities (9.5 &amp; 12 points respectively) E &gt; C on Kaufman mental processing composite at ages 7 &amp; 9 years (.96 sd at 7 yrs, .7z scores at 9 yrs). E = C on PPVT at 7 &amp; 9 yrs.</td>
<td>Maternal outcomes: Parenting: E &gt; C on parent and teacher ratings of school functioning at 9 years. E &lt; C on teacher ratings of attention problems at 9 yrs. Psychosocial function at 12 months: HH = HH/HV = HV = C on depression (CES-D) HH = HH/HV = HV = C on family adaptability and cohesion scales.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Home health care: health care was provided at home for up to 1 month after discharge. Home visiting: involved monitoring the health and development of the infants, providing support to parents and providing referral to other health and social services.</td>
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<td>Schooling: E = C in academic achievement at 7 years E &gt; C in maths &amp; riddles (but not reading) at 9 yrs. E &lt; C in special educational placement (9 vs. 21). Twice as many C as E children had been retained in grade but the difference was not significant.</td>
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</table>
Table 1.6. Details of parent-focused early childhood interventions which examine the effect of intervention on maternal mental health

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample</th>
<th>Intervention</th>
<th>Short term effects</th>
<th>Longitudinal Effects</th>
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<tbody>
<tr>
<td>Infant Health and Development Program, USA (IHDP, 1990; Brooks-Gunn et al, 1992, 1993, 1994, 1994b; McCorten et al 1997; McCormick et al, 1998)</td>
<td>8 site randomized trial. 985 low birthweight (≤ 2,500g), preterm (gestational age ≤ 37 weeks) randomized to intervention (n = 377) or control (n = 608). 93%, 82% &amp; 89% followed up to age 3 years, age 5 years &amp; age 8 years respectively</td>
<td>Intervention from birth to 3 years involved home visits and centre based care</td>
<td><strong>Child outcomes</strong>&lt;br&gt;IQ:&lt;br&gt;E = C at on Bayley mental at 12 months &amp; Bayley motor at 12 &amp; 24 months&lt;br&gt;E &gt; C on Bayley mental at 24 months (9.3 points, .59SD) E &gt; C on Stanford Binet at 36 months (9.75 points; .59 SD)&lt;br&gt;E &gt; C on PPVT at 36 months (6.4 points)&lt;br&gt;Adjusted odds ratio of having an IQ &lt; 70 was 2.7 times greater in the control group.</td>
<td><strong>Child outcomes</strong>&lt;br&gt;IQ:&lt;br&gt;E = C on WPPSI at 5 &amp; 8 years&lt;br&gt;E = C on PPVT at 5 &amp; 8 years&lt;br&gt;But heavier low birth weight infants (HLBW) (&gt; 2,000g) in E group had significantly higher IQ than HLBW infants in C group at 5 &amp; 8 years (3.7 &amp; 4.4 points respectively) &amp; PPVT at 5 &amp; 8 years (6 points &amp; 6.7 points respectively)</td>
</tr>
<tr>
<td><strong>Home visits:</strong>&lt;br&gt;Weekly for 1st year and fortnightly from 1 to 3 years. Two pronged approach involving teaching problem solving skills to the mother and early stimulation activities.</td>
<td><strong>Behaviour:</strong>&lt;br&gt;E group had fewer behaviour problems than C group (-.2SD) at 36 months. 13.9% of E group vs. 18.8% C group had scores above the cut off indicating clinically significant behaviour problems.</td>
<td><strong>Health:</strong>&lt;br&gt;E &gt; C on morbidity</td>
<td><strong>Schooling:</strong>&lt;br&gt;E = C on reading and mathematics scores&lt;br&gt;But HLBW in E group &gt; HLBW in C group on mathematics score&lt;br&gt;E = C on grade retention and placement in special education at 8 years</td>
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<tr>
<td><strong>Child development centres:</strong>&lt;br&gt;Child attended centre for five days a week from 1 to 3 years. Staff child ratios of 1:3 and 1:4 for 1 and 2 yr olds respectively</td>
<td><strong>Maternal Outcomes:</strong>&lt;br&gt;Maternal life course:&lt;br&gt;E &gt; C on employment at 3 years&lt;br&gt;<strong>Psychosocial function:</strong>&lt;br&gt;E &lt; C on maternal distress at 1 &amp; 3 yrs (-0.18 SD at year 1, -0.15sd at year 3) E = C on coping strategies at 3 yrs</td>
<td><strong>Schooling:</strong>&lt;br&gt;E = C on child behaviour checklist (parent rating) at 8 years 8% E and 12 % C had scores above the clinically cut off</td>
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</table>
Table 1.6. Details of parent-focused early childhood interventions which examine the effect of intervention on maternal mental health

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample</th>
<th>Intervention</th>
<th>Short term effects</th>
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<tbody>
<tr>
<td>Australia (Armstrong et al, 1999, 2000;</td>
<td>181 high risk families randomized to intervention (E n = 90) or control (C n = 91)</td>
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<tr>
<td>Fraser et al, 2000)</td>
<td>88% followed up to 4 months 76% followed up to 12mths</td>
<td>Intervention from birth to 6 months.</td>
<td>Maternal outcomes</td>
</tr>
<tr>
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<td>Home visits by child health nurses weekly for 6 weeks, fortnightly to 3 months and monthly to 6 months. Focus on raising the self-esteem of the mother, providing anticipatory guidance on child rearing issues, promoting health and providing referrals to other services.</td>
<td>Parenting: E &gt; C on HOME at 4 months E &gt; C on 3 subscales of the parent domain of the parenting stress index at 4 months E = C on HOME at 12 months E = C on child abuse potential inventory at 18 months</td>
</tr>
<tr>
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<td></td>
<td>Psychosocial function: E &lt; C on depression scores &amp; % classified as clinically depressed at 6 weeks E = C on depression at 4 months &amp; 12 months</td>
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<td></td>
<td><strong>Child-Parent Enrichment Project, USA (Barth et al, 1988)</strong></td>
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<td></td>
<td></td>
<td>Intervention from pregnancy for 6 months</td>
<td>Maternal outcomes</td>
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<tr>
<td></td>
<td></td>
<td>The intervention involved home visits twice a month by paraprofessionals. The home visitors helped the mothers identify goals and plan how to meet them and provided referral to other services.</td>
<td>Psychosocial function: E = C on depression (CES-D) and anxiety (The State-Trait Anxiety Inventory) E = C on social support</td>
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<td><strong>STEEP (Steps to Enjoy Effective Parenting), USA (Erikson et al, 1992)</strong></td>
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<td></td>
<td></td>
<td>Intervention from pregnancy to 1 year</td>
<td>Maternal outcomes</td>
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<tr>
<td></td>
<td></td>
<td>The intervention involved fortnightly home visits and fortnightly group meetings. Focus is on increasing maternal sensitivity to her infants needs and increasing her responsiveness.</td>
<td>Psychosocial function: E &lt; C on depression and anxiety Life course: E &gt; C on life management skills</td>
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<td></td>
<td></td>
<td></td>
<td><strong>Child outcomes</strong></td>
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<td></td>
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<td></td>
<td>Behaviour: E = C on child attachment</td>
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<td></td>
<td></td>
<td></td>
<td>Maternal outcomes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Parenting: E &gt; C on understanding babies needs E &gt; C on HOME</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Psychosocial function: E &lt; C on depression and anxiety Life course: E &gt; C on life management skills</td>
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</tbody>
</table>
1.8. Early Childhood Education in Developing Countries

There are a few studies which have examined the efficacy of early intervention programs in developing countries. In this section, studies of psycho-social stimulation with undernourished children are summarised, followed by a description of studies for children living in poverty.

1.8.1. Studies with undernourished children

Several studies have involved early education for undernourished children and these studies have been reviewed in sections 1.3.4. and will be briefly summarised here.

IQ, school achievement and school progress:

These studies showed that psycho-stimulation for undernourished children can produce long term benefits on children’s IQ (McKay et al, 1978; McGregor et al, 1997; Walker et al, 2000) and school progress (McKay et al, 1978). Measures of school achievement have shown little benefit from early education with two studies finding no benefit (Chang et al, in press; McGregor et al, 1994) and one showing no benefit to arithmetic or knowledge and a benefit in reading for boys only (Super & Herrera, 1991).

Child behaviour:

Three studies reported measurements of child behaviour. In Bogota, Mora et al (1979) reported that infants receiving stimulation cried less while in Jamaican study with severely malnourished children the children in the control group played less and stayed in closer proximity to their mothers than children in the intervention group (McGregor et al, 1989b). However, in the study with stunted children in Jamaica, no benefits to child behaviour observed at home was found after 6 months of intervention (Meeks-Gardner et al, 1999).

Child growth:

In the two Jamaican studies, no benefits to child nutritional status were found for the children receiving psycho-social stimulation (McGregor et al, 1994; Walker et al 1991;
In the Cali study, the longer the period of intervention the greater the gains in height and weight (Perez-Escamilla & Pollitt, 1995) but these gains were no longer present 3 years post intervention. However, in this study, the intervention combined health, nutritional supplementation and stimulation and hence the effect of stimulation alone cannot be determined. Only one study, in Bogotá, reported benefits on growth from a programme of psychosocial stimulation. No benefits on child height and weight were found post-program at age 3, but by age 6 children in the maternal education group were significantly taller than the controls (Super et al, 1990).

**Maternal behaviour:**
Three studies examined the effect of parent-focused early intervention on maternal behaviour and only one reported a benefit (Mora et al, 1979). The two studies from Jamaica found no differences in maternal behaviour observed at home (Meeks-Gardner et al, 1999) or in a laboratory setting (Grantham-McGregor, 1989b).

**Conclusion:**
To conclude, studies in developing countries have shown that early stimulation can have lasting effects on the cognitive function of undernourished children. The lack of benefit to school achievement is disappointing and may reflect the poor quality of the schools. Evidence of the benefits of psychosocial stimulation on child growth, child behaviour and maternal behaviour is mixed and I could not locate any studies in which the effect of early intervention on mother's parenting knowledge or on maternal psychosocial function and life course was examined.

**1.8.2. Studies with Disadvantaged Children**
Studies examining the effects of early childhood education on disadvantaged children in developing countries are not as rigorous as the studies reviewed in developed countries. Only one used random assignment (Powell & Grantham-McGregor, 1989) and this was included in the review in section 1.7.1. Most studies compared children receiving early education with non-participant children and the groups were either not comparable
(Bekman, 1990; Cooper et al, 2002) or no evidence was given of similarity amongst groups as comparisons were made cross-sectionally. However, in spite of their methodological weaknesses, these studies illustrate the benefits of early education on child development.

**Indonesia:**
The PANDAI Project in Indonesia is aimed at improving the development of children from birth to age 5 years. The program involves home visits conducted by paraprofessional volunteers attached to the health centers. Parents are taught how to monitor their child’s development, appropriate play activities are demonstrated and good parent-child interactions are promoted. A pilot project has been evaluated in which 150 children receiving the intervention were compared with 150 children from a community without the intervention program (WHO, 1999). Pre and post tests were conducted and the children receiving the intervention showed gains in motor and mental development and parents provided a more stimulating home environment. The project has now been added to existing child health services but in a much diluted version and no further evaluations have been conducted.

**South Africa:**
A pilot study in a peri-urban community in South Africa (Cooper et al, 2002) provided support for pregnant women until the 6th month of their infant’s life. Mothers were visited at home 18 times by community workers: twice prenatally and 16 times postnatally. During the visit the focus was on increasing the mother’s sensitivity to her infant, giving advice on infant care and development and providing emotional support for the mother. At 6 months, mothers in the intervention group \((n = 32)\) were compared with mothers from a neighbouring community matched for maternal age, parity and marital status \((n = 32)\). There were no significant differences in maternal depression but mothers in the intervention group were more sensitive and more expressive with their child.
**India:**

The Integrated Child Development Service (ICDS) is a nationwide scheme serving 17.8 million 0-6 year old children in India. ICDS provides nutritional supplementation, health care and preschool education to children less than 6 years of age and nutrition and health care to pregnant and lactating women. The early childhood education component involves informal preschooling for 3-6 year olds in courtyards, supervised by paraprofessional staff. An evaluation of ICDS was carried out by Chaturvedi et al (1987) who compared two areas with similar demographic characteristics, one area with and one without the ICDS in operation. They compared more than 96% of all children in the 2 areas when they were aged 6-8 years on cognitive tests, school attendance, exam marks and teacher ratings of the children’s behaviour. In the ICDS region, children enrolled in school earlier and a greater percentage were in school (89.2% versus 78%), although the difference was found for females only. Children from the ICDS area also attended school more regularly and had better academic performance and school behaviour than children from the control area. Differences in the children’s cognition were also found with 36% of children in the ICDS area and 18.5% of children in the control area having an IQ ≥ 75th percentile.

**Turkey:**

A study in Turkey (Bekman, 1990) investigated the effect of attending preschool on child development by comparing children attending educationally oriented preschools, custodial preschools and no preschool. In addition, the effect of a home visiting, maternal-training component was examined. Half of the children in each of the preschool groups (educational, custodial or none) were enrolled in a home enrichment programme of fortnightly home visits by a paraprofessional in which mothers were shown educational activities to do with their children. In addition, group meetings were held on a fortnightly basis. 251 low income families with children aged 3-5 years were included in the study. The results showed that children attending educational preschools had greater gains on IQ and school achievement through the first three grades of school and were also found to be less aggressive, less dependent and better adjusted in school. However, the mothers of the children attending educationally oriented preschools were
better educated. The maternal training program also benefited the children’s IQ, school achievement and social behaviour (the children were found to be less dependent, less aggressive and have a higher self concept) and was found to benefit children in custodial and home care the most. The maternal training program also had clear benefits on the parenting behaviours of the mothers. Mothers receiving home visits reported spending more time playing with and reading to their children and were observed to use more praise and positive feedback in a teaching situation. In addition, mothers receiving the maternal training program participated more in family decision making and had more optimistic expectations of the future.

Peru:
Project PRONEI is an early childhood care and education program in Peru targeting children aged 3-5 years of age and involves a half day, non-formal preschool staffed by paraprofessionals from the community. Food is given to the children at lunchtime and the children are taught activities based on a Piagetian curriculum. Evaluations of this program have been done in 3 regions comparing communities with and without the PRONEI program (WHO, 1999). Pre and post test evaluations were completed for a small sample only and the majority of the comparisons were on post test only. The PRONEI intervention had a significant benefit to children’s mental, motor and social development in one region only. However, in the 2 regions showing no benefit, the mothers of the control children were better educated. The pre and post test comparisons showed a greater benefit for children with initially lower development.

Schooling:
Myers (1992) reviews 13 studies in developing countries for evidence of the effect of early education on schooling. Reports from Asia, Latin America and the Middle East were included and for the most part involved program evaluations rather than rigorous research studies. 6 out of 8 studies that examined age of school enrolment found that children receiving early education enrolled earlier than the control children. 6 out of 9 studies showed improvements in school progress in terms of lower rates of grade retention and/or less school drop-out and the differences between intervention and
control children were most marked for the most disadvantaged. In addition, 6 out of 10 studies showed benefits to school achievement for children in the intervention group.

**Summary of Studies in Developing Countries**

To conclude, early education programs in developing countries, using paraprofessional staff and limited resources, have shown benefits to child cognition and behaviour and to school enrolment, school progress and school achievement. Parent-focused home visiting interventions have been used with children less than 3 years of age and child-focused centre based programs with preschool age children. Few studies have reported on maternal outcomes but there is some evidence that early childhood programmes in developing countries, as in developed countries, can produce benefits to mothers, especially to mother’s parenting skills.
1.9. Who Benefits Most from Early Interventions

In resource poor countries it will not be feasible to provide early childhood interventions for all children and appropriate targeting will be necessary to ensure that the program is provided for the mothers and children who need it most. This section will examine evidence from child-focused and parent-focused interventions in the developed and developing world to ascertain who benefits the most from early interventions.

1.9.1. Child Outcomes

Child Ability

Early education programs have been found to benefit children with initially lower levels of development in several studies. For example, Lee et al (1989) compared children who had attended Head Start with disadvantaged children with no preschool experience and disadvantaged children attending other pre-school programs after one and two years of formal schooling. Although the groups were not randomly assigned a range of social and economic factors were measured and controlled for in the analysis as was the initial developmental level of the child. After one year of school, children who had attended Head Start showed significant gains in cognition over both comparison groups and further analysis showed that this benefit was found for black children only and the gains were greatest for children with lower developmental levels on enrolment. After two years in school these benefits for children of lower ability were no longer evident and the authors attributed to the poorer quality of the schools attended by these children (Lee et al, 1990). The PRONEI program in Peru (WHO, 1999) also benefited children with lower developmental levels at pre-test.

Further evidence of the advantages of early childhood interventions for children with initial lower ability comes from studies which target such children for enrolment into the project. For example, the Perry Preschool project enrolled children with IQs between 70 and 85 from low SES backgrounds at age 3 to 4 years old. The children were randomly assigned to attend part day preschool during the school year for 2 years or a control
group. Although cognitive gains for children in the intervention diminished over time, benefits of intervention were found in school achievement and fewer placements in special education (Schweinhart & Weikart, 1983). This project is important for the long term follow up of the participants. 117 of the original 123 (95%) subjects were followed up at age 27 and benefits were found in terms of lower levels of criminality, less receipt of welfare, higher earnings and fewer out of wedlock births (Figure 1.5.) (Schweinhart et al, 1993).

**Figure 1.5. The Perry Pre-School Project: 27 year follow up**

![Graph showing follow up data](Schweinhart et al, 1993)

All of the examples given above are from child-focused, primarily centre based services and I am aware of no study which showed greater gains for lower ability children in parent-focused programs.

**Gender**

Benefits have been reported to be specific for boys and girls and it is generally the gender most disadvantaged in that population on the outcome in question that benefit. For example, in the evaluation of the Integrated Child Development Service (ICDS) in India (Chaturvedi et al, 1987) it was found that the positive effect of the intervention on school enrolment was for girls only as most of the boys in the control group were
enrolled in school. In the Infant Health and Development Program (IHDP), intervention mothers were less likely to use violent discipline practices with their sons than control mothers (Berlin et al, 1998) while in the Bogota study, supplementation had an beneficial effect on cognition concurrently for girls only whereas maternal education resulted in improved reading skills for boys only 3½ years after the end of the intervention (Super & Herrera, 1991).

**Child Biomedical Status**

Both of the early childhood education programs with low birth weight infants and their families (Table 1.6.) showed benefits of intervention on child development. Similarly, all of the projects described in section 1.3.4. involving psychosocial stimulation for undernourished children produced cognitive gains for the intervention group compared with a group on undernourished children not receiving stimulation.

An example of early intervention being more effective for children who are biologically vulnerable comes from the Abecedarian project. Children with an Apgar score < 9 at 1 minute benefited more from the intervention than children with an Apgar score of 9 or 10 (Figure 1.6.) (Breitmeyer & Ramey, 1986). Therefore, it would appear that early childhood education benefits children at biomedical risk.

**Figure 1.6. IQ at age 4½ of Intervention and Control Children in the Abecedarian Project by Apgar score.**
**Family Background**

Several studies have reported that early childhood education produces cognitive gains for children from more disadvantaged backgrounds. For example, benefits were found for poor, unmarried teenagers in New York (Olds et al, 1986) and for children of Spanish speaking Latinas in California (Wagner and Clayton, 1999). In the IHIDP, the intervention resulted in improved cognition and fewer behaviour problems for children of less educated mothers although amongst children of better educated mothers, no benefits of intervention on child behaviour or cognition were evident (Brooks-Gunn et al, 1992). Similarly in Myers (1992) review of the effect of early childhood education on schooling in developing countries, the greatest differences between children in intervention and control group were found for the most disadvantaged. For example, in a study in 14 rural villages in India, school dropout by grade 3 was much greater for non-ICDS children in the lower and middle castes than for children in the lower and middle castes who had attended ICDS. However, no difference was found among children in the higher castes (Figure 1.7.).

**Figure 1.7. School drop out for children with and without experience in ICDS according to caste**

![Bar chart showing school dropout for children with and without ICDS experience by caste](From Myers, 1992)
The benefit of stimulation to the most disadvantaged is analogous to findings from studies of nutritional supplementation. For example, in the Guatemalan study described in section 1.3.3., children from low SES families benefited the most in terms of cognition at age 4-5 years and on school achievement in adolescence (Pollitt et al, 1993) (Figure 1.8.).

**Figure 1.8.** Long term effect of high calorie and protein supplement on vocabulary by SES in Guatemala

![Graph showing the long term effect of high calorie and protein supplement on vocabulary by SES in Guatemala.](image)

Pollitt et al 1993

**Maternal IQ**

Early childhood education has been shown to be particularly beneficial to children of mothers with low IQ. For example, in the Abecedarian Project, children were randomly assigned to attend an intensive, high quality early education centre from early infancy until age 5 years or a control group (Ramey et al, 1984). All of the children in the intervention group whose mothers had an IQ of less than 70 scored had IQs greater than 85 at 3 years compared to only one child in the control group (Ramey & Ramey, 1992).

In contrast, there is some evidence that it is the children of mothers with higher IQ that benefit most from nutritional supplementation during the first few years of life. For
example, among stunted children receiving supplementation in early childhood, only
those children of mothers with higher IQ showed benefit on tests of perceptual-motor
function at age 7-8 years (Grantham-McGregor et al, 1997). Similarly, in Bogota, among
children with mothers with more psychological resources, those receiving
supplementation benefited more in tests of reading readiness 3½ years after the end of
the intervention period (Super & Herrera, 1991).

Maternal Psychosocial Function
The evidence of maternal mental health moderating the effect of early interventions on
child outcomes is equivocal and only two studies were found examining this. Lyons-
Ruth et al (1990) conducted a non-randomised study of home visiting for high risk
families. The development of the children was compared to other high risk families not
receiving the intervention and a community control group. Among children of depressed
mothers, those receiving the home visiting had significantly higher scores on the Bayley
mental scale at 18 months than children of depressed mothers in both the untreated high
risk families and the community sample. There were however, no treatment effects for
the children of non-depressed mothers. In the Infant Health and Development Program
(IHDP) however, there was no interaction between treatment and depression in
predicting child cognition or behaviour with depressed and non-depressed mothers
benefiting equally from the intervention (Klebanov et al, 2001).

1.9.2. Maternal Outcomes
Fewer studies have examined which mothers benefit most from early intervention
programs. However, the available evidence suggests that for the maternal outcomes, as
with the child outcomes the early childhood education programmes benefit those that
need them most. Two studies reported particular benefits for certain subgroups in
maternal-child interaction. Booth et al (1989) found that among mothers with poor social
skills, those receiving treatment had more positive interactions with their children than
those in the control group while Beckwith (1988) reported that it was the mothers at
higher psychosocial risk (women who had no prenatal care and women from
disorganized homes) that showed greatest gains in observed involvement and responsivity with their infant.

Only the IHDP reported on which mothers benefit most in terms of psychosocial function and the effect of intervention on maternal emotional distress was greater for less educated women and women with less active coping strategies (Klebanov et al, 2001).

The nurse home visiting programme in Elmira, New York reported on child welfare indicators and maternal life course. Fewer child injuries and fewer cases of child maltreatment during the 1st 2 years of life were found for mothers with little sense of control over their lives compared with similar mothers in the control group (Olds et al, 1986) while in a 15 year follow up of the same program the intervention was found to be beneficial to the women classified as poor and unmarried at enrolment on levels of criminality, child bearing and reliance on welfare (Olds et al, 1997).

In contrast, an example of an intervention benefiting mothers who are more advantaged is the nurse home visiting program in Memphis (Kitzman et al, 1997). Only the women with high psychological resources (the sum of maternal IQ, maternal mental health and maternal self-efficacy) had fewer subsequent pregnancies after receiving the intervention.

1.9.3. Summary of Who Benefits Most from Early Interventions

The available evidence suggests that early childhood education (ECE) interventions generally benefit those children who are most vulnerable. For example, children of low ability, children who are undernourished, children born low birth weight, children from disadvantaged backgrounds and children whose mothers have low IQs have been shown to benefit more from ECE interventions than their more advantaged peers. Similarly, the mothers benefiting most from parent-focused early childhood interventions are often those at higher risk.

There is little data indicating who benefits most from supplementation studies. However, there is a suggestion that nutritional supplementation is particularly beneficial for children of mothers with higher levels of psychological resources and for children from poorer homes.
1.10. Program Characteristics Affecting Success

Several studies have investigated the factors which affect the success of early childhood interventions on child and maternal outcomes. These are discussed in the following section.

1.10.1 Intensity

The intensity of the intervention has been found in several studies to affect the success of the intervention. A study in Jamaica investigated the effectiveness of differing intensities of a home visiting intervention (Powell & Grantham-McGregor). The intervention involved home visits for 2 years by paraprofessionals in which home made toys and books were brought to the home and the caregivers shown age appropriate activities to do with their child. Children receiving weekly visits were compared with those receiving fortnightly and monthly visits and a non-visited control group. The gains in child development were found to increase with increased frequency of visiting (Figure 1.9).

Figure 1.9. Effects of Different Visiting Frequency on Child DQ in Jamaica

![Figure 1.9. Effects of Different Visiting Frequency on Child DQ in Jamaica](image)

Powell & Grantham-McGregor, 1989
Increased duration of intervention also resulted in increased cognitive gains in the combined health, nutrition and stimulation study in Cali with (McKay et al, 1979) – see Figure 1.2.

A dose-response effect of treatment on parenting outcomes was reported by Olds et al (1986) in a nurse home visiting program. Women were randomized to receive prenatal visits only, pre and post-natal visits and a control group. The group receiving pre and post natal visits scored higher than the group receiving prenatal visits only who in turn scored higher than the controls on two subscales of the HOME.

Ramey et al (1992) devised a ‘family participation index’ by summing the number of days each child spent in the centre, the number of completed home visits and the number of parent meetings attended. The index was positively related to child cognition in a dose response manner (Figure 1.10.). Comparable levels of participation were found for mothers of different ethnicity, education and for children of different birth weights, gender and neonatal health status as well as across 8 geographical sites. However, it is still possible that some unmeasured factor covaried with both participation and child IQ.

**Figure 1.10. Degree of participation in IHDP and intellectual functioning at age 3**
There is some evidence that the effect of the intensity varies as a function of the characteristics of the participants. For example, in a study with mothers of preterm infants, a one hour session promoting maternal sensitivity and responsiveness was sufficient to produce significant benefits to maternal interaction at 5 months for well-educated mothers (Kang et al, 1995). However, for mothers with lower levels of education an additional follow on intervention of home visiting was required for significant differences to be evident.

A relationship between degree of participation and child and/or maternal outcomes has not been found in all programs which have undertaken this analysis. For example, in the Comprehensive Child Development Program (St Pierre & Layzer, 1999) no statistically or educationally significant differences were found for families with high levels of participation. However, in the latter study as there were no benefits for the sample as a whole, it could be that the quality of the program was insufficient.

1.10.2. Quality

We would expect that the quality of the program would be an important factor influencing outcomes and yet few projects have examined this issue. In Columbia, ‘Homes of Well-Being’ are supported in which community mothers (para-professionals) look after up to 15 children aged 2 to 5 years. Children are fed, their growth is monitored and educational activities are conducted. An evaluation of the programme was conducted in which influences on children’s development were examined using multi-variate analysis (WHO, 1999). No relationship was found between duration of time in the program and the risk status of the children. There was however a small, but significant association (r = .17) between program quality and child well-being in terms of nutrition, health and psychosocial development. In addition, the proportion of children with a developmental delay was lower in homes run by the more experienced community mothers. These results suggest that the quality of the programme was more important in predicting child development than the quantity of exposure the child received.
The Victoria Day Care Research Project in Canada found that the quality of child care was highly predictive of child language development and this was particularly important for children of low SES (Goelman & Pence, 1987).

In the multi-site Comprehensive Child Development Program gains for the intervention group were found for child IQ, mother’s parenting attitudes and the number of mothers in paid employment in one site only (St. Pierre & Layzer, 1999). The authors attributed this success to factors reflecting program quality including a clear focus on child education, low turnover of senior staff and support at the state level.

1.10.3. Maintaining Interest

A common feature of parent-focused early childhood education programs is the high level of attrition as mothers in the intervention group opt out of the program. For example, in the Hawaii’s Healthy Start Program (Duggan et al, 1999) over 51% of the families in the intervention group were classified as ‘inactive’ at the one year evaluation and only one third of the families participated for the full five years in the Comprehensive Child Development Program (St Pierre & Layzer, 1999). In the Infant Health and Development Program, 81 families in the intervention group did not participate in the program defined as at least one home visit and one day per year in the centre (Liaw et al, 1995). Furthermore, even when families remain actively involved in the programme the majority of the studies that provide information on project implementation report that fewer contacts were actually made with the families than was intended in the project design (Wasik et al, 1990; Olds et al, 1986; Kitzman et al, 1997; IHDP, 1990).

This failure to maintain the interest and participation of parents may be an important reason for the equivocal results of parent-focused interventions. For example, Osofsky et al (1988) found no benefits of a program of home visiting for teenage mothers (see table 1.4.). However, on reviewing the charts for each family it was discovered that nearly half of the mothers in the intervention group were not ‘taking’ the program (defined as keeping appointments and following through on activities). By 6 months there were few significant differences between ‘takers’ and ‘non-takers’ of the program but significant
differences emerged at later assessments including higher scores on the Bayley mental scale and more positive maternal child interaction at 13 months and higher scores on the HOME at 3 years for participants classified as ‘takers’. It should be noted however that the mothers who did not ‘take’ the program were at higher psychosocial risk and hence it may be that the outcomes reflect this higher risk status rather than lack of participation in the intervention.

1.10.4. Appropriateness of the intervention
Consideration of the appropriateness of the intervention for the target group is also important when designing early childhood interventions.
Different interventions have been differentially effective for different subgroups in some studies. For example, in the study by Barnard et al (1998), two models of home visiting for pregnant women with low levels of social support were compared. Mothers classified as ‘high risk’ benefited more from a mental health curriculum whereas ‘low risk’ mothers benefited more from a directive educational curriculum.
Boocock (1995) describes a retrospective study in Japan which compared children who had attended private preschools, government-subsidised child care programs or no early childhood out of home care on national achievement tests at 5th grade. Although it was found that children with experience of either type of child care had higher test scores than children with no preschool experience, further analyses revealed that children from low SES families did better if they attended the subsidized child care programs rather than the private educationally oriented preschools. These studies point to the importance of the ‘fit’ between the targeted participants and the type of intervention provided.
Another example of the importance of designing appropriate interventions is the home visiting program in Bermuda (Scarr & McCartney, 1988). Few differences were found on a vast array of maternal and child outcomes after 2 years of intervention. However, it was also reported that over 70% of children in both the intervention and control group were attending group care for at least part of the time. It is possible that the benefits accrued by the children from the centre based programs overshadowed the benefits from home visiting.
1.10.5. Timing

There is limited evidence from the literature as to the optimal time to begin an intervention for young children and their families. Timing is usually confounded with duration. Ramey & Ramey (1998) summarise evidence from the early education literature and conclude that programs which begin earliest and continue longest produce the greatest effects although they cite only child-focused, centre based programs to support their view.

In determining the optimal period to begin parent-focused interventions, some advocate starting during pregnancy or as soon after birth as possible as this is considered a ‘touchpoint’ when mothers are likely to be particularly open to advice and support (Myers, 1992; Olds & Kitzman, 1999). However, in the review of parent-focused programs in section 1.7, only seven out of fourteen programmes beginning before the child was 6 months old showed gains to child development. Of these seven programs, six showed no benefits of intervention at earlier ages (Gutelius et al, 1972; Thompson et al, 1982; Andrews et al, 1982; IHDP, 1990; Rauh et al, 1982).

The reason for limited gains of intervention in infancy is unclear. It could be that interventions are generally ineffective in terms of improving cognition in infancy. Alternatively, there could be a ‘sleeper’ effect of intervention. For example, in the mother-infant transaction programme, intervention from birth to 90 days had no effects on child development before age 3, but benefits were found from age 3 to 9 years. In addition, as the development of disadvantaged children has been reported as being average or above average in the first year it is possibly that intervention in early infancy can help to prevent the decline in development typically seen from the 2nd year of life. Finally, the tests of child development used may be too general to measure differences in child cognition in infancy as they rely heavily on sensory-motor activities.

1.10.6. Summary of Factors Affecting the Success of ECE Interventions

In conclusion, the available evidence points to the importance of high quality and intensive early childhood education interventions for significant gains to be evident for both children and their mothers. It is also important to ensure the intervention is not only appropriate to the target population but also addresses their perceived needs if interest in the program is to be maintained. There is insufficient evidence to determine the optimal age to begin early childhood interventions.
1.11. Groups versus individual format of service delivery

Several parent-focused early childhood education programmes have used a group format to deliver the intervention to parents. The three Parent Child Development Centres (PCDC) described by Andrews et al (1982) utilised centre based services and all three studies showed benefits to the intervention group for both child and maternal outcomes (Table 1.4.). However, the intervention involved a considerable investment of the mothers time and the rate of attrition was high. Low attendance of parent group meetings has also been reported in other projects (for example, IHDP, 1990; Baker et al, 1999). It may be that group meetings are appropriate for certain sub-groups of parents. For example, in the HIPPY project, different family characteristics were associated with participation in the fortnightly group sessions than the fortnightly home visits (Baker et al, 1999). Families most likely to participate in home visits were more advantaged (in terms of more education, lesser likelihood of being on welfare, having more educational materials in the home and higher expectations for their children) while those most likely to participate in the group sessions were comparatively less advantaged (more likely to be single parents, on welfare and have a higher child/adult ratio in the household).

A study in Canada involving weekly self-help groups for mothers of very low birth weight infants during the first few months of their infants life reported high compliance with 50% of the mothers attending all the scheduled sessions, 25% missing only one session and all of them attending at least one third (Minde et al, 1980). We could speculate that the mothers in this study had an increased interest in receiving child rearing information after giving birth to a highly vulnerable infant. The intervention was successful in improving maternal-child interaction and increasing the self-confidence of the mothers in their parenting skills.

Only one study to my knowledge has scientifically investigated the efficacy of groups versus individual visits in early childhood education programmes (Slaughter, 1983) (Table 1.4.). Mothers were randomly assigned to a home visiting group or a discussion group. Both groups were compared with a control. Mothers in the discussion group
interacted with their child and expanded their child’s play significantly more than mothers in both the home visiting and the control group. Furthermore, children of mothers in the discussion group verbalized more during play. However, children in the home visiting intervention scored significantly higher than the controls on the verbal subscale of the McCarthy scales of mental development whereas for children in the discussion group intervention, the scores approached, but did not reach significance. Mothers in the discussion group also scored significantly higher than both comparison groups on a measure of social values and the author concluded that overall the discussion group format was the most effective.

A recent meta-analysis of fifteen randomized controlled trials was conducted to determine the effectiveness of group based parenting programmes on maternal psychosocial function (Barlow et al, 2002). Most of the programs were for parents of children with behaviour problems. Significant differences favouring the intervention group were found for depression (effect size (ES) = -0.3); anxiety/stress (ES = -0.5); self-esteem (ES = 0.4) and relationship with partner (ES = 0.4). No significant gains were found to measures of social support. At follow up of 2-6 months post intervention only the differences in self-esteem remained significant (ES = 0.4). This suggests that using groups as a service delivery option may improve maternal psychosocial function at least while the intervention is ongoing.

Other projects have examined the efficacy of groups in the context of providing health care to mothers with young children. For example Osborn & Woolley (1981) compared mothers who had received group child health supervision from their pediatrician with mothers who received individual appointments in the traditional way. Mothers expressed similar satisfaction with both forms of care but mothers receiving group care sought less advice between visits and completed more visits than mothers receiving individual care. A further study from the same research group found that more of the content of the recommended topics for child health supervision were covered in the group format than in individual visits with no greater input in time (Dodds et al, 1993). Other studies report no difference on measures of parenting, social support and maternal mental health.
between mothers receiving group health supervision and those receiving individual visits (Rice and Slater, 1997; Taylor and Kemper, 1998).

Summary of use of group sessions as a mode of service delivery
From the above studies we can conclude that utilizing a group format for parent-focused interventions is an effective method of service delivery and has proved at least as effective as individual care in studies of health care provision. However, in some projects attendance at group meetings was low and it is important that the intervention is suitable for the target group.

1.12. The Cost of Early Childhood Education Programs

The cost of early childhood care and development programs is obviously an important consideration for resource poor countries. A cost-benefit analysis of the Perry Preschool Program in the US estimated that for every dollar invested in the program, $5.73 have been saved in terms of education, welfare and the criminal justice system (Haskins 1989). However, Barnett (1997) points out that the costs of early childhood education programmes in high income countries are often 5-10 times the per capita gross national product of low income countries and may be even more. In addition, the percentage of children aged 0 to 6 years of age is much higher in low income countries and hence Western models of ECE will not be financially feasible. Young (1995) gives some examples of costing data: the ICDS in India is estimated to cost one fifteenth of the minimum wage, the PRONEI program in Peru costs one fourteenth of the minimum wage while a program of parent education in Chile costs one fifth of the minimum wage per child. The costs of ECE in low income countries have not been systematically examined and the relative costs of different service options is unclear. However, it is generally recognized that pre-schools and child care centres staffed by professional teachers are cost prohibitive. The coverage of such programmes remains low and the costs to be borne by families high and hence services are unlikely to be accessible to ‘at risk’ families. The challenge is to design services which are of sufficient quality to make an impact and which are targeted to the children who need them most.
1.13. Study Context

1.13.1. Background to Jamaica

Jamaica is the third largest island in the Caribbean Sea with an area of 10000 square kilometres. It is located approximately 960km south of the mainland of the USA and 145km south of Cuba. The population of Jamaica is about 2.5 million (PIOJ, 2001) and is predominantly of African descent with approximately 96% of the population being black or coloured. The remaining 4% of the population are of East Indian, Chinese and European descent. There are 14 parishes in the island with two main urban centres, the capital city, Kingston and Montego Bay on the North coast. The population is relatively young with 33.5% below 15 years of age, 57.8% between the ages of 15 and 64 and 8.6% age 65 and above (PIOJ, 2001).

The economy of the island is largely dependent on tourism, bauxite and agriculture. The estimated per capita GNP in 1999 was $2330 (UNICEF, 2001). However the income distribution is highly skewed and there is a broad poverty base. The literacy rate for adults is 76% and the primary school and secondary school enrollment are 94% and 65% respectively.

The crude birth rate and crude death rate in 1999 was 21 and 6 per 1000 respectively (PIOJ, 2001). In 1999 the infant mortality rate was 10 per 1000 (UNICEF, 2001). These indices have shown sharp declines over the past 4 decades.

The State of the World’s Children (2001) reports an 11% incidence of low birth weight. The nutritional status of children under 5 is reported as 5% are moderately or severely underweight, 3% have severe or moderate wasting and 6% have severe or moderate stunting. These figures represent a decline in the prevalence of undernutrition in young children over the past decade reducing from between 6-8% in 1990.
The mean household size in Jamaica is 3.5 and 42.5% of households are headed by women. The proportion of households headed by females is highest among the poorest quintile and lowest among the richest.

1.13.2. The Primary Health Care System in Jamaica

The primary health care system in Jamaica is available to all at low cost. A network of health centres is available nationally and provides the following clinics for mothers and children: maternal and child health, nutrition, family planning and immunization. There is a strong community emphasis with home visiting being an integral part of the service especially for non-attendees and families at particular risk.

All children who attend the maternal-child health clinics are weighed and those found to be underweight (< -2 SD of the NCHS references) are routinely referred to the nutrition clinics for more specialized care from a qualified nutritionist. Nutrition clinics are held monthly and involve the nutritionist monitoring the child’s growth, offering nutritional advice to the mother and providing food supplements. Supplements vary depending on availability but typically consist of packets of rice, cornmeal and soya mince.

The staffing of the health centres varies with the most basic Type 1 health centers staffed by a nurse or midwife and at least two community health aides. However, the majority of health centres are managed by a Public Health Nurse who has a midwife or nurse, pharmacist and community health aides to assist her. A doctor visits the health centres on a regular basis.

The community health aides are women who are literate but have low levels of education. They assume duties after a period of one month of initial training and their duties include work in the health centre and in the community. In the health centre they weigh and measure the children and pregnant women, take temperatures, do simple dressings and keep records of patient visits. In the community, they are responsible for visiting non-attendees, making clinic appointments and providing guidance on family planning, nutrition and immunizations. The community health aides are also trained to
collect data for government health surveys. There are an estimated three CHAs per 10,000 of the population and their gross pay is approximately US$420 per month.

1.13.3. The Child Rearing Environment

Roberts and Sinclair (1978) developed a three point classification of mating relationships in Jamaica:

1. Married: man and women are married and live together in the same household
2. Common law: in which the man and woman live together but are not joined in marriage
3. Visiting union: in which the man and women share a sexual relationship but do not live together in the same household

This classification also describes the stages of the mating pattern for poor Jamaicans with young women up to about age 25 typically involved in visiting unions and then progressing to a common law union and eventually marriage.

Leo-Rhynie (1997) describes two features of family organisation in Jamaica which have a large impact on the child-rearing environment. One is the dominant role of women and the other is the marginality of men. There is a high number of female headed households and a high incidence of children born out of wedlock. Women generally start their family early to gain status in the community. Also, having a baby is often viewed as a way of stabilizing a relationship with the father and securing financial assistance. However, the men may leave and women often have a series of visiting relationships and a number of children by different men. Men do not always assume responsibility for their children and are often reluctant to take on the children of another man. All these factors lead to women having primary responsibility not only for rearing the children but also for providing for the family economically. In some cases, the mother is unable to care for her child when she seeks employment out of the home and this leads to 'child shifting' which describes the child being sent to live with a relative or friend.

Studies of child rearing patterns in Jamaica describe frequent use of punitive discipline practices, few toys or playthings and a lack of verbal interaction in many families (Leo-
Rhynie, 1993, 1997; Walker & Grantham-McGregor, 1990). Add to this the overcrowded homes in urban areas, the poor standard of housing, the lack of male involvement in child rearing, poverty and the crime and violence common in many urban neighbourhoods and it is clear that poor, Jamaican children have many risk factors in their lives which can have a deleterious effect on their development.

1.13.4. Development of Jamaican Children

Jamaican children have precocious development in the first year of life compared to the norming population of the developmental tests. However, a marked decline in development is evident in the second year for children from disadvantaged backgrounds while children from more advantaged backgrounds continue to improve in development (Figure 1.11.).

Figure 1.11.: Development of urban Jamaican children by social class

In addition, the profile of the scores for Jamaican children, especially those living in poverty, differs from that found in the norming populations of the test. The tests are designed so that for children following a normal developmental trajectory the score on
each subscale is similar. However, previous studies in Jamaica have shown an uneven profile across the subscales with locomotor scores being particularly high and scores on the performance subscale which measures problem solving ability being particularly low (Powell, 1990; Walker & Grantham-McGregor, 1990).

1.13.5. The Study Area

The study was carried out in the parishes of Kingston and St. Andrew and St. Catherine. St. Catherine is predominantly rural but only the highly urbanised centres were included in this study. This includes the parish capital, Spanish Town and Portmore.

The health centres included in the study were Harbour View, Windward Road, Rollington Town, Norman Gardens, Hagley Park, Olympic Gardens, Maxfield Comprehensive, Comprehensive, Duhaney Park, Stony Hill, Edna Manley, Bustamante in the Kingston and St. Andrew area. In St. Catherine, Waterford, Christian Pen, Central Village, St. Jago Park, Cumberland Road and Sydenham were the health centres involved.

The majority of these health centres serve communities in the densely populated and highly urbanised areas. These communities have high unemployment with those employed in low-paying unskilled jobs. Crime rates are generally high. Families typically live in ‘yards’ characterised by several families sharing one premises. Each family has private sleeping quarters but toilet and water facilities are often shared.

Two health centres (Cumberland Road and Harbour View) served peri-urban communities and one (Stony Hill) served highly rural communities. Families in these communities are less likely to inhabit shared premises and crime and violence is much less of a problem. Unemployment is however, a common problem in these areas.

The health centres serve a wide catchment area and hence some families live a considerable distance away.
1.14. Justification for the Study

This thesis reports on two studies, a case-control study comparing mothers of undernourished children with mothers of adequately nourished children and a randomised controlled trial of psychosocial stimulation for undernourished children enrolled in government nutrition clinics. Justification for each study is provided in this section.

1.14.1. Justification for the Case-Control Study

Previous studies in developing countries, including Jamaica have shown that undernutrition covaries with a range of other risk factors for child development. Undernourished children come from less stable and poorer homes than adequately nourished children in the same community. Furthermore, a lower quality of stimulation is available to them. There is however, little information regarding the factors which affect the mothers parenting ability. These factors are discussed in section 1.2.2. and include social support, depression, parenting self-esteem and stressors. It is important to understand the parenting environment in which children live if we are to design appropriate and effective interventions. Hence in this study mothers of undernourished children were compared with mothers of adequately nourished children in a case-control study.

1.14.2. Justification for the Treatment Trial

The benefits of early childhood stimulation for vulnerable children have been discussed in sections 1.7 and 1.8. The review demonstrated that quality programs designed to meet the needs of the target population produce benefits for children from disadvantaged backgrounds. Furthermore, many parent-focused programs have been shown to produce benefits to mothers in terms of their parenting ability and life course. There are however, few studies that have reported benefits to mothers mental health from parent-focused early interventions. Studies for undernourished children were discussed in section 1.3.3. These studies have also demonstrated benefits of psychosocial stimulation with long term effects on child IQ being reported. However, benefits for mothers have been more
elusive and I am aware of no study that has investigated the effects of intervention on mother's child-rearing knowledge and practices or on maternal psychosocial function.

Three previous studies in Jamaica have been reviewed, one with stunted children, one with severely malnourished children and one with disadvantaged children. All three studies demonstrated the effectiveness of a low-cost, parent-focused intervention using home made toys in improving child outcomes. However, there is no evidence of their effectiveness in producing benefits for the mothers. Furthermore, previous studies have been highly controlled research studies and if the program is to be made available to all children in need, the efficacy of the activities when integrated into existing services needs to be established.

The primary health care system in Jamaica offers the only national source of contact accessing a wide cross-section of the population from birth up until age 3 or 4 when many children enter basic school. Thus, the most feasible way of ensuring integrated services for undernourished children is through the primary health care system. The health centres also have a cadre of workers of a similar level of education and skill as the home visitors used in previous Jamaican studies – the Community Health Aides.

The use of group sessions for delivering a service of parent-focused early childhood care and development has been reported for a few studies and the literature suggests that such an approach does produce benefits for the children and mothers involved. There is some evidence that use of groups leads to a more client-led service with more of the mothers needs and issues being discussed. In addition, use of a group session is an effective use of time, a critical feature within a heavily burdened primary health care system.

Thus in this study, we planned to integrate a parent-focused early childhood education intervention into the existing health and nutrition services in Jamaica using government Community Health Aides to deliver the programs to the mothers and children. A group format for service delivery was deemed the most feasible approach.
Chapter 2: Aims and Objectives

2.1. Long-Term Goal
The long term goal of the research was to establish a sustainable service whereby psychosocial stimulation for undernourished children was integrated into routine health and nutritional care. The research thus involved working with staff employed in government service and children and mothers attending government health centers.

2.2. Aims
The main aim of the research was to integrate an intervention of early child development into existing health and nutrition services for undernourished children in 2 parishes in Jamaica (Kingston & St. Andrew and St. Catherine) and to evaluate the effect on the children and mothers.

An additional aim was to utilize a case control study at baseline to compare mothers of undernourished children with mothers of adequately nourished children attending the same government health centres on certain family and maternal characteristics.
2.3. Objectives

2.3.1. Case-Control Study

1. To compare mothers of undernourished children attending government nutrition clinics with mothers of adequately nourished children attending the same health centers matched for the age and sex of the children on the following:
   - depressive symptoms
   - parenting self-esteem
   - stimulation provided by the mother
   - social support
   - daily stressors.

2. To examine the independent correlates of stimulation in the home

3. To examine whether depressive symptoms, parenting self-esteem and stimulation in the home were independently associated with undernutrition controlling for socio-economic variables, stressors and social support.

*We hypothesised that:*

1. The mothers of undernourished children would be more depressed, have lower self esteem, more stressors, less social support and provide poorer stimulation in the home than mothers of adequately nourished children

2. Psychosocial function would independently predict stimulation in the home after controlling for socio-economic factors and

2. Poor stimulation in the home would mediate the effect of poor psychosocial function on nutrition.
2.3.2. Longitudinal Study

1. To determine the feasibility of integrating psychosocial stimulation into primary health care nutrition services for undernourished children.

2. To utilise a randomised controlled study design to determine the effects of the above psychosocial stimulation for a period of one year on:
   - The children’s psychomotor development and nutritional status
   - The child rearing knowledge and practices of the mother
   - Maternal depression

3. To determine the relationship between growth and change in child development

4. To examine if the intervention benefits some mothers and children more than others.

5. To determine the relationship between aspects of program implementation (number of sessions attended, quality of the CHA and cooperativeness of the mother) and change in child development and maternal child rearing knowledge and practices and frequency of depressive symptoms.

6. To determine the relationship between of change in maternal knowledge and practices and the frequency of the mothers depressive symptoms and change in child development.

We hypothesized that:

1. Utilising group session would prove a feasible and effective strategy for integrating psychosocial stimulation activities and parenting education into existing nutrition and health services.
2. The addition of a parent-focused early childhood education component would produce benefits to the child’s developmental level as measured by a standardized test, the child’s behaviour as rated during the test and the mother’s child rearing knowledge and practices.

3. Previous studies in Jamaica found no effect of psychosocial stimulation on child nutritional status and thus we did not predict that growth would be one of the benefits in this study. We did however predict that growth, particularly height gain, would predict change in development.

4. Child characteristics (e.g. initial developmental level, initial nutritional status) and maternal characteristics (e.g. maternal IQ, maternal social support) would moderate the effect of the intervention on child outcomes

5. Maternal characteristics (e.g. maternal IQ, maternal social support) would moderate the effect of the intervention on maternal outcomes

6. The number of sessions attended, the quality of the CHA and the cooperativeness of the mother would be predictive of change in child and maternal outcomes

7. Change in maternal child-rearing knowledge and practices would predict change in child development.

We had no hypothesis regarding the effect of the intervention on maternal depression as the literature provides no clear evidence of the effect of parent-focused programs on the mother’s mental health.
Chapter 3: Methods

3.1. Description of the Study

The study comprised two parts, the first was a cross-sectional study in which two groups, undernourished children and adequately nourished children were enrolled. The second was a randomised controlled trial of early child development activities in which the sample of undernourished children were randomly assigned by clinic to receive psychosocial stimulation in addition to the standard nutrition and health care or standard nutrition and health care only. A diagram of the study design is provided in Figure 3.1. below:

Figure 3.1. Study Design
3.2. Sample

Undernourished children

Undernourished children were identified and recruited from 18 nutrition clinics (held in the government health centres) in the parishes of Kingston, St. Andrew and the urban areas of St. Catherine. All nutrition clinics within Kingston and St. Andrew were included in the study except for 2 clinics which were excluded due to their distance from the university. Nutrition clinics were stratified into 2 groups by size and then randomly assigned to intervention and control groups. Randomisation occurred at the level of the clinic as it was considered unethical to randomise within the health centre. Preliminary investigation of records indicated that there should be sufficient children attending nutrition clinics in Kingston and St. Andrew to fulfill the sample size requirements. However, fewer children were available than had been anticipated. This led to an expansion of the study region to include urban St. Catherine. The 6 clinics in St. Catherine were stratified by size and 4 were randomly assigned to intervention and 2 to control to ensure equal numbers of children in the intervention and control groups.

The recruitment criteria were:

1. Enrolled in nutrition clinic
2. Between 9 months and 30 months of age
3. Weight for age currently below −1.50z scores of the National Centre of Health Statistics (NCHS) references and have been below −2z scores in the last 3 months
4. Birthweight greater than 1.8kg
5. Singleton birth
6. Child and mother resident in the clinic catchment area
7. Absence of chronic disease and/or obvious disability
8. Maternal consent

139 mother-child dyads from 18 clinics were successfully recruited into the study. 7 mothers (5%) refused to take part; 6 were from the intervention group (8.5%) and 1 from the control group (1.5%). 11 clinics were intervention clinics and 7 clinics were control. Between 3 and 20 children were recruited from each clinic. 70 children were recruited from the intervention clinics and 69 from the control clinics.

Mothers were first approached either at the health centre when attending nutrition clinic or
for non-attendees at home. The child was weighed to determine if the nutritional status of the child met the inclusion criteria. The purpose and extent of the study was explained verbally and following this written consent of the mother was requested. A copy of the consent forms used in the study are provided in Appendix 1.

Adequately nourished children
In each health centre, every other undernourished child was matched for sex and age (in two age bands: 9-18 months or 19-30 months) with an adequately nourished child attending the mother and child health clinic. The well-nourished children had a weight for age above –1.0z scores of the NCHS references. 71 adequately-nourished children and their mothers were recruited into the case-control study.

3.3. Sample Size
Sample Size Calculation for Case-Control Study
With equal number of cases and controls a sample size of 86 in each group would be required to detect a difference of half a standard deviation in maternal depression, parenting self-esteem, social support, stressors and stimulation in the home with a power of 90% and at the 5% level of significance (Hulley et al, 2001). In this study we recruited twice as many cases as controls and hence 129 cases and 65 controls are required (Kirkwood, 2001).

Sample Size Calculation for Randomised Trial
A sample size of 86 children in each group would be required to detect a difference of half a standard deviation between the groups in child development, child nutritional status, maternal child-rearing knowledge and practices and maternal depression with a 90% power at the 5% level of significance (Hulley et al, 2001). We were unable to recruit the required number of children even after adapting the inclusion criteria (by increasing the age range and the weight for age) and enlarging the study area. 62 children in each group is sufficient to detect the same difference at an 80% power at a significance level of 5%.

3.4. Ethical consent
Ethical consent was given by the University of the West Indies Medical Sciences Ethics
Committee and the Ministry of Health in Jamaica.

3.5. Description of the Measurements Used in the Study
The measurements taken in the study and the initials of the personnel involved are shown in Table 3.1. overleaf. All of the personnel were female graduates of the University of the West Indies. The measurements are described in detail below and copies of the questionnaires used in the study are provided in Appendix 3.

Maternal PPVT
The Peabody Picture Vocabulary Test – Revised (Dunn & Dunn 1981) was administered to the mothers individually by a trained female research assistant. This test assesses verbal vocabulary comprehension and is used as a measure of maternal verbal IQ.

Demographic Information
This included questions concerning age of mother, education, occupation, marital status, reproductive history and frequency of child interaction with the biological father.

Mother height
Mother’s height was measured to the nearest 0.1cm using a stadiometer.

Socio-economic status
Socio-economic status included measures of:
Crowding: number of people per room
Sanitation: rating of toilet and water amenities. Toilet facilities were on a scale from 0 (no toilet) to 6 (own inside flush toilet). Water was on a scale from 1 (water > 100 yds outside the yard) to 6 (own inside pipe). The ratings were summed to form a score of 0 – 12.
Possessions: presence of the following items in the home – stove, TV, video, cable TV, radio, fridge, telephone, bicycle, motor bike and motor car. The number of items present was summed to form a summary scale of 0-10.
Table 3.1. Measurements taken in the case-control study and the randomised controlled trial of psychosocial stimulation

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Case-Control Study</th>
<th>Randomised Controlled Trial</th>
<th>Personnel Involved</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Children</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child height and weight</td>
<td>√</td>
<td>√</td>
<td>JT</td>
</tr>
<tr>
<td>▶ at baseline</td>
<td></td>
<td></td>
<td>JT</td>
</tr>
<tr>
<td>▶ at final evaluation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child developmental level</td>
<td>√</td>
<td>√</td>
<td>PA</td>
</tr>
<tr>
<td>▶ at baseline</td>
<td></td>
<td></td>
<td>PA &amp; AM</td>
</tr>
<tr>
<td>▶ at final evaluation</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mothers</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demographic information (baseline)</td>
<td>√</td>
<td>√</td>
<td>MW</td>
</tr>
<tr>
<td>Socio-economic status (baseline)</td>
<td>√</td>
<td>√</td>
<td>MW</td>
</tr>
<tr>
<td>Mother’s height (baseline)</td>
<td>√</td>
<td>√</td>
<td>JT</td>
</tr>
<tr>
<td>Maternal verbal IQ (baseline)</td>
<td>√</td>
<td>√</td>
<td>JT</td>
</tr>
<tr>
<td>Parenting self-esteem (baseline)</td>
<td>√</td>
<td>√</td>
<td>MW</td>
</tr>
<tr>
<td>Social support (baseline)</td>
<td>√</td>
<td>√</td>
<td>MW</td>
</tr>
<tr>
<td>Daily stressors (baseline)</td>
<td>√</td>
<td>√</td>
<td>MW</td>
</tr>
<tr>
<td>Stimulation in the home (baseline)</td>
<td>√</td>
<td>√</td>
<td>MW</td>
</tr>
<tr>
<td>Parenting knowledge</td>
<td>√</td>
<td>√</td>
<td>MW</td>
</tr>
<tr>
<td>▶ at baseline</td>
<td></td>
<td></td>
<td>PA &amp; AM</td>
</tr>
<tr>
<td>▶ at final evaluation</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parenting practices</td>
<td>√</td>
<td>√</td>
<td>MW</td>
</tr>
<tr>
<td>▶ at baseline</td>
<td></td>
<td></td>
<td>PA &amp; AM</td>
</tr>
<tr>
<td>▶ at final evaluation</td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal depression</td>
<td>√</td>
<td>√</td>
<td>MW</td>
</tr>
<tr>
<td>▶ at baseline</td>
<td></td>
<td></td>
<td>PA &amp; AM</td>
</tr>
<tr>
<td>▶ at final evaluation</td>
<td>√</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Child anthropometry

Weights were measured to the nearest 0.1kg using an infant scale. The children were measured without shoes and clothes (including diapers). Length was measured on an infantometer and standing height on a stadiometer to the nearest 0.1cm using standard anthropometric procedures (Lohman et al, 1988). Two research assistants were trained to carry out the anthropometric measurements and the interobserver reliability (intraclass correlation coefficient) for 10 consecutive subjects measured independently was above R > 0.97 for weight, length and height. Anthropometric measures were converted into height for age, weight for height and weight for age and expressed as z scores of the NCHS references according to standard procedures (WHO, 1979).

Developmental Assessment

The children's developmental level was assessed using the Griffiths Mental Development Scales (Griffiths 1967, Griffiths 1970). Only 4 subscales were used – locomotor, hearing and speech, hand and eye coordination and performance. The personal social scale was not used as it is not culturally appropriate for Jamaica. The practical reasoning subscale begins at age 3 and was not used in this study.

Locomotor: assesses gross motor skills such as learning to walk, run and climb. After 2 years control of movement and balance is also measured.

Hearing and Speech: measures expressive and receptive language and has been modified slightly from the original version. Pictures were changed to reflect Jamaican images and some questions were changed into patois. Response by the children in patois was accepted.

Eye and Hand: measures fine motor skills such as stacking blocks, threading beads, use of crayon and paper and use of scissors.

Performance: measures problem solving, spatial relationships and visual perception and includes puzzles and construction toys.

The Griffiths test was developed and normed with British children. It has however been modified and extensively used in Jamaica (Grantham-McGregor and Desai, 1975; Grantham-McGregor et al, 1980, Chambers and Grantham-McGregor, 1986, Grantham McGregor et al, 1987, Grantham-McGregor et al, 1991). The test has been shown to have
good stability in children from 2 to 6 years old in a longitudinal study of 54 children and was found to be highly correlated concurrently with the Stanford Binet and moderately concurrently correlated with PPVT (Grantham-McGregor et al, 1987). The test also had good predictive validity from age 2 to age 6 years with IQ at age 8 to 10 years on the Stanford Binet, at age 15 on the WISC and with later school achievement at age 10 and age 15 years (McGregor et al, 1994).

**Depression**

The depression scale was based largely on the Centre for Epidemiological Studies Depression Scale CES-D (Radloff 1977). The CES-D scale was designed to assess the frequency of depressive symptoms in non-clinical populations. The original scale contains 20 questions. After piloting the wording of the questions was changed and several of the questions were omitted to shorten the instrument. The omitted questions were:

- I did not feel like eating; my appetite was poor
- I had trouble keeping my mind on what I was doing
- I talked less than usual
- People were unfriendly
- I was sad

Respondents are asked how frequently they experienced the symptom in the last week and the number of days was recorded. Three of the questions were worded in a non-depressed direction to assess positive affect and self-esteem and to avoid response set. The following 5 components of depression were measured

- Depressed mood: 5 questions
- Feelings of guilt and worthlessness: 3 questions
- Feelings of helplessness and hopelessness: 4 questions
- Psychomotor retardation: 2 questions
- Sleep disturbance: 1 question

Responses were coded by entering the number of days each symptom was present. Questions worded in a non-depressed or positive direction were reverse coded and added to negative items forming a summary score of $0 - 105$.

The internal reliability of the depression scale was $\alpha = 0.90$. Test-retest over the year of the study was $r = 0.49$. These reliabilities are comparable to those reported by Radloff (1977).
Test-retest was between 0.45 and 0.70 and internal reliability was reported as $\alpha = 0.90$ in a clinical population and $\alpha = 0.85$ in the general population.

**Parenting self-esteem**

Parenting self esteem encompasses both perceived self-efficacy and the satisfaction derived from parenting (Coleman & Karraker, 1997).

Parenting self-efficacy: measured confidence in one’s parenting ability. This questionnaire was specifically designed for use in the study and was based on the aims of the intervention curriculum. Self-efficacy was construed as being situation specific (Bandura, 1989) and ten of the eleven 4-point self efficacy items addressed mothers feelings of competence in relation to specific parenting acts such as coping with sickness, feeding, showing love and affection, teaching, providing a stimulating environment and discipline. One item referred to global feelings of efficacy in parenting. Mothers were asked to rate themselves as good (3), okay (2), have some trouble (1), or not so good (0) on a range of parenting tasks. These responses were drawn on a ladder which the mothers used as a visual aid when answering the questions.

Parenting satisfaction: describes the quality of affect associated with parenting and the degree of satisfaction derived from it. The six questions were drawn from the Maternale morale Index (Salt, 1988) and the Parenting Stress Index (Abidin, 1986). A 4-point response scale was used: agree completely (0), agree a little bit (1), disagree a little bit (2) or disagree completely (3).

Item scores for the satisfaction and self-efficacy subscales were summed to yield a parenting self-esteem score of 0-51. The internal reliability of the scale $\alpha = 0.81$.

**Stressors**

The stressors questionnaire was designed for use in this study and comprised 8 questions. These questions addressed some of the most common problems faced by low income
Jamaican mothers. These include violence in the community, yard and household, food security, insufficient income and stressful interpersonal relationships.

The items in the stressors scale were factor analysed using varimax rotation and four factors emerged explaining 75.13% of the variance. These factors were labeled economic stress (Eigenvalue = 2.7, variance explained = 33.2%), partner stress (Eigenvalue = 1.3, variance = 15.9%), domestic violence (Eigenvalue = 1.1, variance explained = 13.6%) and community violence (Eigenvalue = 1.0, variance explained = 12.5%). The questions loading on each factor and the factor loadings are given in Table 3.2. below:

Table 3.2. Factor analysis of the stressors scale: questions loading on each factor and the corresponding factor loading

<table>
<thead>
<tr>
<th>Factor 1: economic stress</th>
<th>Factor 3: domestic violence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular income</td>
<td>Fighting &amp; quarreling in</td>
</tr>
<tr>
<td># of times last week there</td>
<td>yard</td>
</tr>
<tr>
<td>was no food in house</td>
<td>Mother or child hit or hurt</td>
</tr>
<tr>
<td>Receives money from man</td>
<td></td>
</tr>
<tr>
<td>Factor loading</td>
<td>.81</td>
</tr>
<tr>
<td>.78</td>
<td></td>
</tr>
<tr>
<td>.73</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factor 2: partner stress</th>
<th>Factor 4: community violence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Man gives trouble</td>
<td># people shot or stabbed</td>
</tr>
<tr>
<td>Get along with man</td>
<td>last month</td>
</tr>
<tr>
<td>Factor loading</td>
<td>.88</td>
</tr>
<tr>
<td>.76</td>
<td>.95</td>
</tr>
</tbody>
</table>

Social support

This questionnaire was based on the Medical Outcomes Study Social Support Survey (Sherbourne and Stewart 1991) designed for use in the general population. The instrument measures four aspects of functional support: emotional support, tangible support, positive
social interaction and informational support. However, the range on social interaction and informational support was found to be narrow on piloting and hence only two aspects of social support were retained in the present questionnaire: tangible support (3 questions) and emotional support (2 questions). Mothers were asked if they received specific types of support on a 5-point scale of no (0) to a little of the time (1) through to always (4). The response set was presented on a pictorial ladder scale to facilitate understanding. Responses were summed to form a cumulative score of 0-20. The internal reliability of the social support scale was $\alpha = 0.66$.

**Knowledge**

The knowledge questionnaire was designed as an outcome measure for the intervention curriculum and consisted of 20 questions. A combination of closed and open questions were used. Question 1 was not coded and was used to orientate the mothers to the questionnaire and to encourage them to talk openly and freely. Topics covered in the questionnaire included the importance of love and praise, discipline, appropriate feeding practices, use of positive teaching strategies, how to stimulate language development and appropriate activities and learning experiences for young children. The closed questions were scored on a scale: agree completely, agree a little bit, disagree a little bit and disagree completely. Questions were coded so that more child rearing knowledge was associated with higher scores. The open questions were coded by examining the 20 questionnaires administered for test-retest and assigning codes based on the mother’s answers. A score was assigned for the number of positive suggestions given by the mother. A list of these suggestions is provided in Appendix 2. A total score for the knowledge subscale was achieved by summing the responses to the open and closed questions and the maximum score was 70.

The test-retest for the knowledge scale over the year of the study was $r = 0.58$.

**Home Observation for Measurement of the Environment**

The HOME instrument (Caldwell, 1967) measures the responsiveness and stimulation of the home environment through a combination of systematic observation and maternal report. The infant/toddler version is for children aged birth to 3 years and consists of 45 items in 6 subscales:
1. Emotional and verbal responsivity of the caregiver
2. Avoidance and restriction of punishment
3. Organisation of the physical and temporal environment
4. Provision of appropriate play materials
5. Caregiver involvement with child
6. Opportunities for variety in daily stimulation

The HOME has been used in many studies and scores on the HOME have often been reported to be related to child developmental levels (for example, Duncan et al, 1994; Korenman et al, 1995; Brooks-Gunn et al, 1993b).

The HOME questionnaire has been modified for use in Jamaica previously and the scores of pre-school children were a significant predictor of change in the Griffiths hearing and speech subscale over 2 years (Grantham-McGregor et al, 1991). For this study, further adaptations were made including the addition of more questions relating to activities the mother does with the child (to correspond to the intervention curriculum) and extending the response scale beyond a dichotomous response.

The scale used in this study consisted of 15 maternal report items and 31 observations. Responses to questions were coded on a six point scale: never or less than once a week (0), once a week (1), 2-3 times a week (2), 4-6 times a week (3), every day (4) or more than once a day (5). The majority of the observations were scored to indicate whether the behaviour occurred or not. All items were coded so that a high score indicates higher and more appropriate maternal behaviour. The final HOME score was calculated by summing the items to give a cumulative score of 0 – 96. The internal reliability of the scale was $\alpha = 0.80$.

**Child-Rearing Practices Subscale**

The maternal report questions of the HOME were used in the evaluation of the intervention curriculum and were measured pre- and post-test in the undernourished group. The observations were not repeated at final evaluation due to lack of resources to allow a home
visit. The questionnaire comprised 15 questions which were summed to give a maximum score of 62. The internal reliability of the practices scale was $\alpha = 0.77$. Test-retest over the year of the study was $r = .61$.

**Rating of the Quality of the Community Health Aides**
The program supervisor and principal investigator rated each community health aide that conducted the intervention on a 5 point scale: very good, good, average, poor and very poor.

**Rating of the Cooperation of the Mother in the Program**
Near the end of the intervention period and before the child was tested each CHA rated the level of maternal cooperation for each mother she visited on a 5 point scale: very good, good, average, poor and very poor.
3.6. Piloting of Instruments
The following questionnaires scales underwent 3 phases of piloting after the initial drafting: parenting knowledge, depression, parenting self-esteem, daily stressors, social support and the HOME. Each pilot phase was implemented with mothers similar to those who would be enrolled in the study.

*Phase 1: Qualitative Pilot*
The questions were asked in an open manner and mothers were encouraged to reflect on the questions and what meaning they attributed to them. Any ambiguous questions or questions which were misunderstood were re-phrased and the piloting continued until the researcher was satisfied that the questions were clearly interpretable and culturally appropriate. In this form of piloting there is no prescribed number of respondents that need to be interviewed. The number interviewed is dependent on how much piloting is required to design a questionnaire that is clearly understood by the target group. The response scales to be used were also piloted - different scales were used and the mother’s opinion sought on which scale was easiest and most meaningful for her.

*Phase 2: Quantitative Pilot*
The questionnaires were then administered to between 15-20 mothers and the range of responses was examined. Any questions with a very narrow range were rephrased or omitted.

*Phase 3: Test-Retest*
All questionnaires were administered with 20 mothers and then re-administered two weeks later. Individual items with a low test-retest reliability were omitted. The test-retest for the complete scale of each questionnaire was calculated using intraclass correlation coefficient. The test-retests over a two week period in the piloting stage were: depression, \( R = 0.71 \); self esteem, \( R = 0.95 \); stressors, \( R = 0.95 \); social support, \( R = 0.86 \); knowledge, \( R = 0.71 \) and stimulation in the home, \( R = 0.98 \).

3.7. Training
Training of Interviewers

One interviewer was trained to give the baseline home questionnaire and two different interviewers were trained to give the final questionnaire. Training involved:

- ensuring the interviewers had a good conceptual understanding of each scale and the meaning and purpose of each question.
- giving clear instructions on how to probe ambiguous responses
- learning how to recognise and deal with common problems
- stressing the importance of an empathetic, open and friendly manner with both mother and child
- for the baseline questionnaire which involved observations of mother-child interaction clear instructions were given on how to conduct the interview to ensure comparability of observations
- administration of the questionnaire until the trainees were fluent and comfortable and thoroughly familiar with each question

The final stage of training involved administering the questionnaire with the trainer until an interobserver reliability > 0.9 was achieved for each question in 10 consecutive interviews. The trainer observing 10% of the interviews with the study mothers ensured on-going training and quality control. The interobserver reliability was > 0.9 for all questions on all the questionnaires used throughout the study.

Training of Testers Responsible for Developmental Assessments

All of the developmental assessments at baseline were carried out by a single tester. Reliabilities (intra-class correlation coefficients) between the tester and trainer before the study began $R = 0.98$ ($n = 10$) and in ongoing quality control were $R = .99$ ($n = 16$). At final evaluation, developmental assessments were conducted by two testers and inter-observer reliabilities between the two testers were $R = 0.99$ ($n = 16$). Test-retest for global DQ and each subscale over the year of study were DQ ($r = 0.51$), locomotor ($r = 0.48$), hearing and speech ($r = .36$), hand and eye ($r = .20$) and performance ($r = .35$).

3.8. Procedure of the Study
**Undernourished Children**

All undernourished children were identified from the clinic records. Developmental assessments were administered in the health centres. After the test session, the maternal PPVT was administered to the mother, the mother’s height was taken and the weight and length of the child recorded. Shortly after the testing session the mother was visited at home by a different interviewer and a questionnaire administered designed to obtain information regarding demographics, maternal psychosocial functioning and parenting behaviours. As far as possible, a quiet area of the house or yard was identified and the interview was conducted in private with only the mother and child in earshot.

At the end of the study, the child was again tested in the health centre, the child’s weight and height was measured and a questionnaire was administered to the mother which included parenting knowledge and practices and depression. All questionnaires were administered in a face to face interview with the mother. The tester and interviewers were unaware of the children’s group assignment at baseline and at follow up. As far as possible, all measures were equally spread across groups and between testers/interviewers across time. However, at baseline, due to the insufficient number of children recruited from the Kingston and St. Andrew clinics and the subsequent expansion of the study area (and randomisation of more clinics to the intervention rather than control group) there was a slight inbalance in the testing.

**Adequately Nourished Children**

Children attending child health clinic with no record of having attended nutrition clinic were matched with every other undernourished child in each clinic for age and sex. The children were then weighed and if they had a weight for age above \(-1sd\) informed consent was sought from the mother to participate. The child’s length was taken, the PPVT was administered to the mother and her height was recorded. The mother was visited at home a few days later and the questionnaire was given to obtain information regarding demographics, maternal psychosocial functioning and parenting behaviours.

**3.9. Zinc Trial**
100 (72%) of the children enrolled in the psychosocial stimulation randomised controlled trial were also enrolled in a zinc supplementation trial. 27 children enrolled in the first three clinics were excluded from the trial as they were enrolled and all baseline measurements completed 2 – 3 months prior to the start of the zinc trial. In addition 12 mothers (8.6%) refused consent. A study diagram of the combined zinc and stimulation study is provided in Figure 2.2.

Informed consent was obtained from the parents to participate in the zinc trial. Within each clinic children were stratified into two age groups (9 to 18, 19 to 30 months) and randomly assigned to receive the zinc supplementation or placebo. This was a double blind trial as both the parents and the testers were unaware of the children’s group assignment.

**Supplement**

All children received vitamin drops and iron (see Appendix 5 for the vitamin/iron formula). Zinc supplementation comprised 10 mg elemental zinc as sulphate in a flavoured syrup, or a placebo (syrup only) given daily for 6 months. The supplement or placebo was delivered to the homes weekly in 7 pre-measured doses in small bottles by a CHA employed by the study group. After a week, the CHA returned with a fresh set of supplement or placebo and collected the bottles from the previous week. During the visit to the home the CHA also questioned the parent or guardian about the morbidity history of the child during the previous 7 days.

**Additional Measurements**

All children participating in the zinc trial had developmental assessments at the end of the 6 months study period. An equal number of children from the stimulation and no stimulation clinics were tested.
Figure 3.2. Study Diagram of the Combined Zinc Supplementation and Stimulation Randomised Controlled Trial

18 Health Centres

Random

Stimulation
11 Health Centres

6 refusals

70 Children enrolled

Random

1st 11 enrolled & 8 refusals to Zn trial

Zinc
27 children

Placebo
21 children

Not in zinc trial
17 children

3 lost

No stimulation
7 Centres

1 refusal

1st 16 enrolled & 4 refusals to Zn trial

Zinc
22 children

Placebo
24 children

69 children enrolled

Random

1 lost

2 lost

2 lost

2 lost
3.10. The Psychosocial Stimulation Intervention

The original intent was a 12 months intervention involving weekly meetings with small groups of mothers in the health centres. One or two of the community health aides in each health centre would facilitate these meetings with a maximum number of 5 mother-child dyads. Each meeting was scheduled to last one hour.

The format for each meeting involved a group discussion based around a set topic followed by the introduction of age appropriate activities with the child. The activities involved singing, structured games, language activities and use of home-made educational toys. The health aide was provided with guidelines to aid her in leading the group discussion and an activity booklet describing all the required activities. Each session was to start with a feedback period in which the parents discussed progress with last week’s message and activities and to end with a review period in which the parents were reminded of the activities they were to do with the child during the following week.

The guidelines for the group discussions were written specifically for this programme. A curriculum of activities for use with young children in home visiting programmes was already in existence and has been used for many years in early intervention programmes with undernourished children in Jamaica. Aspects of this curriculum were adapted for the present program. The number of home-made toys to be used was reduced and the range of activities to be done with each toy increased. This was to reduce the amount of materials required to run the programme.

The aims of this intervention are summarised below:

1. To increase mother’s knowledge and improve practices pertaining to child rearing with emphasis on encouraging parents to provide a loving, responsive and stimulating environment for their young child.
2. To facilitate mothers towards a more internal locus of control and to increase their self-confidence in their parenting skills.
3. To improve the children’s cognitive, social, emotional, motor and language development
4. To design a sustainable, low cost, culturally appropriate training package for use with parents of children ‘at risk’ for poor developmental outcomes.
Table 3.3. Objectives of the Intervention and how these objectives were to be Achieved

<table>
<thead>
<tr>
<th>Objectives</th>
<th>How achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To increase the participants self-confidence generally but with particular emphasis on confidence in their parenting skills. Includes confidence that they can provide good care for their children physically and that they can provide a stimulating environment for child development</td>
<td>1. The intervention aims to support what parents already do, recognising their existing skills, praising them and providing them with further knowledge and skills and the confidence to use these skills</td>
</tr>
<tr>
<td>2. To further parents understanding that they can affect their child’s development in all dimensions</td>
<td>2. Discussions include the importance of parents in facilitating the learning process in their child in a range of developmental outcomes (for example, a parent’s behaviour can help children be smarter, learn language, be less aggressive, be healthier, grow well, have more self-esteem, be better behaved.</td>
</tr>
<tr>
<td>3. To help parents incorporate child rearing practices likely to promote child development into daily routines / caretaking activities.</td>
<td>3. The intervention includes ideas for activities with children at bath time, mealtimes, while getting dressed, while going for a walk, while performing household chores.</td>
</tr>
</tbody>
</table>
| 4. To increase parent’s knowledge and understanding pertaining to child development and child rearing including:  
  - Knowledge of child developmental outcomes  
  - Understanding children’s feelings  
  - Importance of showing affection and praise  
  - Importance of providing different experiences  
  - The means by which children communicate and how parents communicate with them  
  - Importance of making conversation with the child  
  - Importance of listening and responding to the child  
  - Importance of consistency in caregiving  
  - Psychosocial aspects of feeding  
  - How to make toys  
  - Importance of praising and positive reinforcement  
  - Discipline  
  - How to facilitate learning | 4. Addressed throughout the intervention by means of discussion, demonstration and guided practice |
Table 3.3. (continued): Objectives of the Intervention and how these objectives were to be Achieved

<table>
<thead>
<tr>
<th>Objectives</th>
<th>How achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. To increase parent practices pertaining to child rearing including:</td>
<td>5. An important aspect of the intervention curriculum is demonstrating to the mother a range of age appropriate activities including:</td>
</tr>
<tr>
<td>• Showing affection for the child</td>
<td>• Language activities intended to foster maternal-child communication,</td>
</tr>
<tr>
<td>• Being responsive to the child’s needs</td>
<td>• Games which were fun and interesting ways to</td>
</tr>
<tr>
<td>• Listening to and trying to understand what the child is saying /</td>
<td>teach the child new concepts</td>
</tr>
<tr>
<td>communicating</td>
<td>• Children’s songs and rhymes of varying degrees of difficulty depending on the age of the child</td>
</tr>
<tr>
<td>• Talking appropriately to the child (including labeling objects and</td>
<td>• Provision of home made toys including puzzles, pictures, books, lotto</td>
</tr>
<tr>
<td>actions in the home, explaining to the child about the world around them,</td>
<td>s, balls, dolls, stacking toys, blocks, pull-a-longs and crayon and paper.</td>
</tr>
<tr>
<td>answering the child’s questions &amp; modeling and expanding child’s</td>
<td>Mothers are shown how to use these toys with the child and specific concepts</td>
</tr>
<tr>
<td>utterances)</td>
<td>which are taught</td>
</tr>
<tr>
<td>• Singing with the child</td>
<td>Parents are strongly encouraged to follow their child’s interests when doing the activities and to praise them for their efforts.</td>
</tr>
<tr>
<td>• Sharing books with the child</td>
<td>6. Low cost materials are provided and parents shown how to make simple playthings. Parents are encouraged to discuss other ways in which the toys could be used or other household objects which could be used with young children.</td>
</tr>
<tr>
<td>• Provision of more opportunity for play and an increase in the variety</td>
<td></td>
</tr>
<tr>
<td>of play activities</td>
<td></td>
</tr>
</tbody>
</table>

6. Parents make toys from low-cost materials and throw-away household materials (bottles, bottle tops etc.) and suggest ways to use these toys with their child. Parents are encouraged to be creative in the design and use of home made toys.
3.11. Training Community Health Aides

A five day workshop was held in November, 1999 with 18 community health aides (CHAs) in attendance.

The main objectives of the training are outlined below:
1. To understand the rationale behind the programme
2. To have a basic knowledge of child development including the different dimensions of child development and developmental milestones and the age at which they are reached.
3. To further the participants understanding of what children need for good development
4. To have reviewed the first 10 parenting sessions to be used in the intervention and to understand the content and have role played running the group discussions
5. To introduce the participants to a selection of the home-made toys to be used in the intervention and to role play activities to be taught to young children
6. To have improved the participants teaching skills including giving positive feedback to parents for good contributions and good caregiving, giving negative feedback in a constructive way, managing group discussions e.g. encouraging quiet people to speak and not allowing louder people to dominate the discussion and using prompts to facilitate the discussion
7. To have improved participants ability to teach children including planning appropriate activities for the child’s stage of development, making learning fun, following the child’s lead and how to simplify tasks for the child having difficulty.

The workshop was participatory and involved active learning by the participants. Participants were encouraged to reflect on their own experiences and each session built on their prior knowledge and skills. The training was conducted to reflect the manner we wished the CHAs to conduct the group sessions with the mothers. Teaching methods employed included large and small group discussions, role play, brainstorming, case studies, stories, songs and games. Ongoing evaluation, with feedback of participants comments into planning future sessions was an integral part of the workshop.

Prior to the start of the intervention a further two day training was done in smaller groups
in which the CHAs were provided with the opportunity to practice leading group discussions with volunteer mothers and to demonstrate a variety of activities to mothers and their young children.

3.12. Implementation of Group Sessions

Group sessions were conducted in the first 3 intervention clinics to enter the program. The attendance at these sessions averaged less than 25%. These attendance rates, although low, were only achieved by constantly reminding the mothers to attend by phone and in some cases by providing transportation.

The reasons for the poor attendance were various, for example:

➤ **family responsibilities:** many of the mothers have several young children and attendance at weekly clinic is a problem

➤ **strict dress code:** the health centres have a strict dress code which inhibits some mothers from attending

➤ **distance:** the catchment areas for each clinic are wide and for many mothers a bus ride or even two bus rides away. The bus fares were refunded through the programme but the inconvenience of the public transport which is generally overcrowded and unreliable was a definite obstacle to the program’s success

➤ **cost:** it is customary for mothers to carry bought drinks, snacks and diapers to clinic which means there is a substantial financial outlay involved in attending the sessions

➤ In addition, the programme is targeting ‘at risk’ families and these may be the families least likely to utilise clinic services.

After a 3 month trial period it was decided to return to a model previously used in Jamaica of home visiting. In the past, CHAs have been specifically employed to conduct the home visiting programme but in the current study, CHAs in the government health care centres were delivering the programme. This model is lower cost and has a greater potential for expansion.

3.13. Home Visiting
Despite the change of mode of delivery of the programme, the programme remained faithful to the original aims and objectives. The parenting messages were designed to be introduced and reinforced through discussion with groups of mothers. These messages were written in a shortened form and one message was discussed with the caregiver at each home visit. The home visiting model involved weekly visits to the home by one of the CHAs from the health centre. The visit lasted about half an hour although this was not standardised as it depended on the cooperation of the family. The CHA worked with the primary caregiver (usually the mother) and the child. In cases where the mother worked, the person taking care of the child during the day was involved.

On each visit the CHA introduced a set of activities to mother and child including a song, a language activity or game and a toy, book, picture or crayon & paper. The activities were demonstrated to the mother and she was encouraged to participate. On the next visit, the activities from the previous visit were reviewed and the toy was exchanged for something new. In addition, a parenting message was discussed with the mother. There were 13 messages on the following topics:

1. Love
2. Praise
3. Following what child wants to do
4. Discipline: 3 separate messages
5. Helping a child learn: 2 messages
6. Encouraging a child to eat
7. Responding to your child
8. Show, name & talk
9. Teach child during daily activities
10. Learning should be fun

These messages can be found in Appendix 3.

The visits were planned as a fun and rewarding time for mother and child with an emphasis on positive feedback and reinforcement for both. Mothers were praised for good interactions with their child and complemented on their child’s abilities. Children were not coerced into doing activities and were praised for their efforts.

A record book was kept for each child. For each visit a plan was made and the progress of
the child on each activity was noted. A copy of the sheet used for planning and monitoring visits is provided in Appendix 3.

3.14. Further Training

Due to the change from group session to home visits and the delay in implementing the programme in many of the health centres, a further two day training was conducted with the CHAs from Kingston and St. Andrew. This training acted as a refresher course and also oriented the CHAs to the home visiting programme and introduced the record keeping. In addition, a one week training was conducted with 4 CHAs from health centres in St. Catherine. This training followed a similar pattern to the original training.

3.15. On-going monitoring and supervision

The programme was supervised by the author. CHAs were visited regularly in the health centre (on average very fortnight) to discuss the programme and to review the books of each child. In addition the supervisor accompanied each CHA on the home visits at least once a month and more if problems arose. During the visits an evaluation checklist was completed and this was discussed with the CHA on completion of the visits. A copy of the evaluation checklist can be found in Appendix 3.

The role of the supervisor also included:

- Monitoring the children's progress and discussing with the CHA if the child needed to be moved to an easier or more challenging level of the curriculum
- Supporting the CHAs when the families had problems. Trouble in the home, as would be expected, often led to a reduction in the level of maternal cooperation and a behaviour change in the child – the child either becoming withdrawn or exhibiting more aggressive behaviour. This could lead to discouragement in the CHAs and was circumvented through discussions and problem solving with the supervisor.
- Capacity building of the CHAs – each CHA had different strengths and weaknesses in their ability to execute the programme. The supervisor worked at building on the strengths of each CHA and used positive reinforcement to increase their self-
3.16. Program Staff

One health aide from each health centre was trained to conduct the programme and had responsibility for visiting the children recruited within the centre.

In addition, two health aides were employed privately by TMRI. These health aides had responsibility for:

- Making the toys, puzzles and pictures to be used in the study
- Visiting children who move out of the area or who live a long distance from the clinic
- Visiting a proportion of the children in clinics with more than 6 children enrolled.
- Visiting children from one health center in which the designated CHA refused to cooperate unless a financial incentive was given.

9 government health aides and 2 independent health aides were involved in the study. The government health aides had an average of 4 children to visit (minimum = 3 and maximum = 7).

3.17. Logistical Constraints of the Study

The main logistical constraint faced in this study was insufficient funds which impacted on the research in several ways:

- The case-control study investigated the psychosocial characteristics of mothers of undernourished children, the level of stressors in their daily lives and their available support. Ideally this information would have been used to inform the intervention in the randomised controlled trial. However, mothers and children were recruited over a 6 month period and due to funding pressures it was not feasible to delay the start of the intervention until all the data was collected and analysed. The intervention began in each intervention clinic as soon as all the baseline measurements were completed with...
each mother–child dyad. Hence the results of the case-control study were not used to improve the intervention and the two studies should be viewed as two discrete entities.

- Although we recognised from the outset that developmental assessments on the adequately nourished children would greatly enhance the quality of the study, the cost of including such assessments would have increased the budget beyond the upper limits specified by the funding agency.

- There were no funds available for a pre-pilot project to assess the potential problems in utilising a group approach to deliver the intervention to parents. Piloting the group sessions in advance of the main project would have alerted us to the problem of low attendance and would have enabled us to plan more efficiently for a home visiting service by the community health aides.

- The zinc supplementation study was conceived after the funding for the stimulation study had been granted. The original plan was for all of the children included in the stimulation study to participate in the zinc study. However, there was a delay in getting funding for the zinc trial and the research assistants for the stimulation trial had been hired and were on the pay roll. Hence the stimulation study began before funding came through for the zinc trial and approximately 10% of the children were ineligible for entry into the zinc supplementation study due to this delay.
Chapter 4: Analysis

4.1. Data Entry, Checking and Analysis

All of the data were entered into SPSS by the author and was checked independently. Data were cleaned by examining the frequency distribution of each variable and identifying any outliers or inappropriate coding and any missing data. Individual items in the maternal questionnaires were summed to form subscales. All variables were checked for normality. The depression score was negatively skewed so was normalised with a square root transformation (at baseline and at final evaluation). The social support score was positively skewed and was transformed by squaring. Factor analysis was used to identify the underlying constructs in the stressors scale and the factor scores were used in analysis.

4.2. Case Control Study

Independent samples t-tests for continuous variables and Chi-squared analysis for categorical variables were performed to determine the difference between the undernourished and adequately nourished children on the study variables. Correlation co-efficients (Pearson’s product moment or Spearman’s rank) were computed to examine the relationship between key outcomes and other variables. The key outcomes were maternal depression, parenting self-esteem and stimulation in the home. Stepwise logistic regression was used to examine the factors independently associated with study group (adequately nourished versus undernourished). The odds ratio and confidence intervals were computed. Independent predictors of self-esteem, depression and stimulation in the home were determined by using stepwise linear regression. The standardised beta coefficients and adjusted $R^2$ were computed. Interaction terms were computed between nutritional group and the independent predictors of parenting self-esteem, maternal depression and stimulation in the home. All interaction terms were centred to avoid colinearity. Nutritional group and the interaction terms were then offered in a second step.
4.3. Treatment Trial

Firstly, the effect of zinc supplementation was investigated using the data from the children who participated in the zinc trial only. There was no effect of zinc and no interaction between zinc and stimulation on child development and nutritional status and also as expected there was no effect of zinc on maternal child rearing practices, knowledge and frequency of depressive symptoms. Full details of the analyses used and the results of these analyses are reported in Appendix 5. The effect of psychosocial stimulation on child and maternal outcomes was thus explored using the original 2 group study design (stimulation and no stimulation).

T-tests for continuous variables and chi-squared for categorical variables were used to explore differences between the groups at baseline on family characteristics, maternal characteristics and child’s age, gender and nutritional status expressed in z-scores. T-tests were also used to explore differences between the groups at final evaluation on child nutritional status expressed in z scores and maternal child-rearing knowledge and practices and frequency of depressive symptoms.

To determine if there was significant catch-up in growth, repeated measures analysis of covariance was used on height for age, weight for height and weight for age. The analysis had one between subjects factor, group, with two levels (treatment or control) and one within subjects factor, anthropometry, with two levels (baseline and final evaluation measurements).

The relationship between initial and final child development and child age and gender was explored using correlations and t-tests. As significant negative correlations between child age and initial child development were found, child age was used as a covariate in all analyses involving child development. Differences between the groups on initial and final child developmental levels were thus explored using analysis of covariance (ANCOVA) using child age as a covariate.
4.4. Treatment Effect

The mean number of home visits conducted with mothers and children in the intervention group was 32.5 (Range: 5 - 48). All analyses were conducted on an intention to treat basis. The effect of treatment on change in child development and nutritional status and change in the maternal outcomes was examined using multilevel multiple regression analysis. The data were formatted and entered into MLWin. Multi-level analysis was used to take into account the hierarchical structure of the data as the children were recruited within health centres. Children and mothers within each health centre may be more alike, on average, than subjects from other centres and multi-level modeling takes into this into account and models the health centre variance (Goldstein, 1995). A 2-level structure was used, subjects were assigned to level one and the health centres were assigned to level two.

4.4.1. Anthropometry

To investigate the treatment effect on children’s growth, hierarchical multiple regression was used. Weight and length were analysed in their original units of measurement. This is due to the age range of the children in the sample crossing the 24 months threshold when the NCHS references become discontinuous (Dibley et al, 1987).

Most children (91.5%) had both length and height measured on at least one occasion. The linear regression of these lengths on height was used to convert height to estimated length at those ages when only height was measured (estimated length (cm) = 0.513 + 1.002height). The length-height regression indicated a close correspondence between the two measures (r = .986). All analyses were then carried out with length only.

A discontinuity is also evident at around 12 months in the weight for height standard as infants weight gain relative to height slows around this time and this causes a distortion in the assessment of tall or short children. Cole (1985) thus suggests the use of weight/height $^2$ (body mass index (BMI)) for infants and young children and hence BMI was used as measure of wasting.
In these regressions, the dependent variables were weight, length and BMI and the independent variables were initial anthropometry, age and sex, a dichotomous variable for in the zinc study or not (1 = yes; 0 = no) to control whether the child participated in the zinc trial, and the child's stimulation status coded as a dichotomous variable (1 = yes; 0 = no). In addition, in each analysis, partner stress, which was different between the groups at baseline, was offered at a significance level of p < .05.

4.4.2. Child Development
To investigate the effect of treatment on change in child development, separate regressions were executed for global DQ and each subscale. The independent variables were initial developmental measure and age (to control for initial score and the decline in development with age), the variable for in the zinc study or not (1 = yes; 0 = no), and the child's stimulation treatment status. In addition, in each analysis, partner stress, which was different between the groups at baseline, was offered at a significance level of p < .05. Tester was an additional covariate in each analysis.

4.4.3. Maternal Outcomes
To investigate the effect of treatment on the maternal outcomes, hierarchical multiple regressions were again used and the dependent variables were mother's child-rearing knowledge, child-rearing practices and frequency of depressive symptoms. The independent variables were initial score, the variable for in the zinc study or not (1 = yes; 0 = no) and the child's stimulation status coded as dichotomous variables (1 = yes; 0 = no). In addition, partner stress and tester were offered at a significance level of p < .05. Interviewer was an additional covariate in each analysis.
4.4.4. Interaction terms

To determine if the intervention benefited certain subgroups of children more than others, a series of interaction terms were made and offered in the regressions on treatment effect described in sections 4.4.1. to 4.4.3. at a significance level of $p < .1$. The following interaction terms with child variables were made:

Treatment x initial height, treatment x initial BMI, treatment x initial development measure (DQ and each subscale), treatment x child age, treatment x gender, treatment x school attendance.

Interaction terms were also computed between treatment and the following maternal variables:

Treatment x PPVT (verbal IQ), treatment x initial depression, treatment x initial knowledge, treatment x initial practices and treatment x housing*

These interaction terms were centred to avoid colinearity. Further details of which interaction terms were offered in each regression are provided in the results section.

4.4.6. Further analyses

Further analyses were conducted to examine:

➢ The effect of program implementation on child development and maternal child rearing knowledge, practices and frequency of depressive symptoms
➢ The relationship between growth and global DQ and each subscale
➢ The relationship between change in the maternal outcomes (child-rearing knowledge, child-rearing practices and frequency of depressive symptoms) and global DQ

Full details of these analyses will be provided in the results section.

* A single housing index was formed from the indices of crowding, sanitation and possessions using factor analysis. The resulting factor had an eigenvalue of 1.82 and explained 60.7% of the variance. The factor loadings were: sanitation = 0.81; possessions = 0.79; crowding = -0.73. The housing factor was used as a measure of household wealth.
Chapter 5: Results

5.1. Case-Control Study

All the mothers were interviewed and all the measurements were completed on all subjects. Each scale was checked for normality and transformed where necessary. Social support was positively skewed and was transformed by squaring the total scores. Depression was negatively skewed and was transformed by taking the square root of the total scores.

5.1.1. Differences Between the Nutritional Groups

Background variables

There was no difference between the undernourished and adequately nourished children in birth order or age (Table 5.1.). As expected there were significant differences in their weight for age, height for age and weight for height. In the undernourished group, 67 of the children (48%) were moderately underweight (WAZ < -2z scores) and 14 (10%) were severely underweight.

Table 5.1. Child characteristics by study group

<table>
<thead>
<tr>
<th></th>
<th>Underweight (n = 139)</th>
<th>Adequate weight (n = 71)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>91 girls</td>
<td>45 girls</td>
</tr>
<tr>
<td>Age on enrollment (months)</td>
<td>18.53 4.98</td>
<td>19.38 4.80</td>
</tr>
<tr>
<td>Birth order</td>
<td>2.29 1.60</td>
<td>1.97 1.22</td>
</tr>
<tr>
<td>Weight for height (z score)**</td>
<td>-1.64 .62</td>
<td>.03 1.04</td>
</tr>
<tr>
<td>Weight for age (z score)**</td>
<td>-2.22 .53</td>
<td>.14 1.00</td>
</tr>
<tr>
<td>Height for age (Z score)**</td>
<td>-1.57 .92</td>
<td>.36 .89</td>
</tr>
</tbody>
</table>

***p < .001
There were no significant differences between the groups in maternal age, education, marital status or the number employed (33%) (Table 5.2.).

**Table 5.2. Family characteristics by study group**

<table>
<thead>
<tr>
<th></th>
<th>Underweight (n=139)</th>
<th>Adequate weight (n=71)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Number of children</td>
<td>2.29</td>
<td>1.60</td>
</tr>
<tr>
<td>Crowding</td>
<td>2.84</td>
<td>1.58</td>
</tr>
<tr>
<td>Sanitation*</td>
<td>7.84</td>
<td>3.05</td>
</tr>
<tr>
<td>Possessions***</td>
<td>5.13</td>
<td>1.98</td>
</tr>
<tr>
<td>Mother's age (in years)</td>
<td>25.99</td>
<td>7.34</td>
</tr>
<tr>
<td>Mother's PPVT*</td>
<td>93</td>
<td>21.27</td>
</tr>
<tr>
<td>Mother's height***</td>
<td>159.3</td>
<td>5.9</td>
</tr>
<tr>
<td>Baby father living there %***</td>
<td>41.0</td>
<td></td>
</tr>
<tr>
<td>Mother is employed %</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Mother's work* %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non/unskilled</td>
<td>36.7</td>
<td></td>
</tr>
<tr>
<td>Semi-skilled</td>
<td>42.4</td>
<td></td>
</tr>
<tr>
<td>Skilled</td>
<td>20.9</td>
<td></td>
</tr>
<tr>
<td>Mother's schooling %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; Grade 11</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>Grade 11 – no exams</td>
<td>30.9</td>
<td></td>
</tr>
<tr>
<td>Passed CXC</td>
<td>10.1</td>
<td></td>
</tr>
</tbody>
</table>

***p = .001, * p < .05

The mother's mean age was 26 years and more than half of them had not completed secondary education. Few of the mothers (13.9%) were married. Fewer of the undernourished children's fathers lived with them than in the adequately nourished group (p < 0.001). The undernourished group had significantly worse sanitation scores (p < 0.05) and fewer possessions (p < 0.001), but there was no difference in crowding.
Compared with the controls, the mothers of undernourished children had poorer PPVT scores, lower skilled occupations (both $p < 0.05$) and were shorter ($p < 0.001$).

**Maternal Psychosocial Characteristics and Experiences and Home Stimulation**

The mothers of undernourished children had significantly more depressive symptoms and lower parenting self-esteem than the mothers of adequately nourished children (both $p < 0.01$) (Table 5.3.). They also reported higher levels of economic stress ($p < 0.001$). There were no differences between the groups in partner stress, domestic violence, community violence or social support. The mothers of undernourished children also provided a less stimulating home environment for their child ($p < 0.05$) and had lower scores on the child-rearing knowledge questionnaire ($p < .05$) than mothers of adequately nourished children.

**Table 5.3. Maternal characteristics and experiences and home stimulation by study group**

<table>
<thead>
<tr>
<th></th>
<th>Underweight (N=139)</th>
<th>Adequate weight (N=71)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Knowledge of child rearing*</td>
<td>24.7 5.5</td>
<td>26.4 5.4</td>
</tr>
<tr>
<td>HOME*</td>
<td>46.7 12.4</td>
<td>50.8 14.0</td>
</tr>
<tr>
<td>Self Esteem**</td>
<td>32.2 8.3</td>
<td>35.4 8.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Median</th>
<th>Range</th>
<th>Median</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression**</td>
<td>26 0 - 91</td>
<td>16.5 0 - 86</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social support</td>
<td>16 1 - 20</td>
<td>17 3 - 20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic stress index***</td>
<td>3 1 - 10</td>
<td>1 1 - 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partner stress index</td>
<td>3 1 - 7</td>
<td>3 1 - 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic violence index</td>
<td>1 1 - 6</td>
<td>1 1 - 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community violence index</td>
<td>2 1 - 4</td>
<td>2 1 - 4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*$p < .05$, **$p < .01$, ***$p < .001$;  
* $t$-test of transformed variable  
* $t$-test of factor score
5.1.2. Variables Associated with Depression

Higher maternal depression was associated with increased crowding ($r = .15$, $p < .05$), fewer possessions ($r = -.20$, $p < .01$), lower PPVT scores ($r = -.14$, $p < .05$), being unemployed ($r = -.16$, $p < .05$) and absence of the baby's father ($r = -.22$, $p < .001$). Depression was also associated with increased economic stress ($r = .37$, $p < .0001$), partner stress ($r = .17$, $p < .05$), domestic violence ($r = .17$, $p < .05$), less social support ($r = -.24$, $P < .0001$), lower self-esteem ($r = -.44$, $p < .0001$) and lower scores on the HOME ($r = -.18$, $p < .05$).

In order to determine which variables independently affected depression, a stepwise multiple regression was calculated. All significantly correlated variables were offered, except self-esteem, which is another measure of psychosocial function and the HOME, which is hypothesized to be an outcome of depression rather than a predictor. The independent predictors of depression were increased economic stress ($p < 0.001$), less social support, increased levels of domestic violence and of partner stress (all three $p < 0.05$) (Table 5.4.). These variables accounted for 20% of the variance in maternal depression. Interaction terms between group and the significant covariates were also offered but were not significant.

5.1.3. Variables Associated with Parenting Self-Esteem

Higher parenting self-esteem was associated with increased schooling ($r = .18$, $p < .01$), less crowding ($r = -.15$, $p < .05$), more possessions ($r = .15$, $p < .05$), presence of father ($r = .19$, $p < .01$) and the mother having a more skilled occupation ($r = .21$, $p < .01$). Better self-esteem was also associated with less partner stress ($r = -.18$, $p < .01$), less economic stress ($r = -.23$, $p < .001$), less domestic violence ($r = -.18$, $p < .05$), more social support ($r = .19$, $p < .01$) and less depression ($r = -.44$, $p < .001$) and higher scores on the HOME ($r = .33$, $p < .0001$).

As for depression, the variables correlated with self-esteem (with the exception of the HOME and depression) were offered stepwise in a multiple regression analysis. Four variables accounted for 15% of the variance in maternal self-esteem, less economic
stress, more skilled work of mother (both p<0.001), decreased levels of domestic violence and less partner stress (both p< 0.01) (Table 5.4.). Interaction terms between group and the significant covariates were also offered but were not significant.

Table 5.4. Standardised Beta coefficients (β) and amount of variance explained (R²) from multiple regressions of psychosocial characteristics of mothers with groups combined

<table>
<thead>
<tr>
<th>Depression</th>
<th>Parenting self-esteem</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adjusted R²</td>
</tr>
<tr>
<td>Economic Stress***</td>
<td>.13</td>
</tr>
<tr>
<td>Social support*</td>
<td>.17</td>
</tr>
<tr>
<td>DomesticViolence*</td>
<td>.19</td>
</tr>
<tr>
<td>Partner Stress*</td>
<td>.20</td>
</tr>
<tr>
<td>F = 13.75***</td>
<td></td>
</tr>
</tbody>
</table>

** p < .001, **p < .01, *p < .05

5.1.4. Variables Associated with Home Stimulation

The HOME is a broad indicator of quality of parenting. Higher scores on the home were associated with increased maternal schooling (r = .16, p < .05) and verbal intelligence (r = .36, p < .001), less crowding (r = -.16, p < .05), more possessions (r = .21, p < .01) and presence of the baby’s father (r = .19, p < .01). Higher scores on the HOME were also associated with lower maternal depression (r = -.17, p < .05), higher maternal self-esteem (r = .33, p < .0005), less economic stress (r = -.19, p < .01), less partner stress (r = -.17, p < .05), less domestic violence (r = -.17, p < .05) and more social support (r = .22, p < .01). In order to determine if the mother’s psychosocial characteristics independently predicted the HOME scores, depression and self esteem along with
nutritional group and other significant correlates were offered stepwise in a multiple regression. The variables independently associated with the HOME were higher maternal verbal IQ, higher parenting self-esteem and decreased levels of partner stress (Table 5.5.). These variables accounted for 25% of the variance in HOME scores. Interaction terms between group and the significant covariates were also offered but were not significant.

Table 5.5. Standardised Beta coefficients (β) and amount of variance explained (R²) from multiple regression of stimulation in the home with groups combined

<table>
<thead>
<tr>
<th></th>
<th>Adjusted R²</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPVT***</td>
<td>.12</td>
<td>.36</td>
</tr>
<tr>
<td>Self Esteem***</td>
<td>.23</td>
<td>.30</td>
</tr>
<tr>
<td>Partner stress**</td>
<td>.25</td>
<td>-.16</td>
</tr>
</tbody>
</table>

***p < .001, **p < .01, p < .05; F = 23.39***

5.1.5. Logistic Regression of Nutritional Group

We examined the independent risk factors for undernutrition in a logistic regression of nutritional group. The variables which were significantly different between the groups were offered stepwise (possessions, sanitation, maternal height, skill level of work, depression, self-esteem and verbal IQ, the presence of the baby’s father, economic stress, stimulation in the home). The independent predictors for being undernourished were low maternal height, higher levels of economic stress, lower skill level of work, the baby’s father not living in the household and fewer possessions. The model correctly placed 77.7% of the sample. The odds ratios and 95% confidence intervals are given in Table 5.6.
Table 5.6. Logistic Regression on Study Group

<table>
<thead>
<tr>
<th></th>
<th>Odds Ratio</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal height</td>
<td>.893</td>
<td>.845, .944</td>
</tr>
<tr>
<td>Economic stress</td>
<td>1.623</td>
<td>1.051, 2.508</td>
</tr>
<tr>
<td>Skill level of work</td>
<td>.692</td>
<td>.489, .979</td>
</tr>
<tr>
<td>Father not there</td>
<td>2.162</td>
<td>1.087, 4.301</td>
</tr>
<tr>
<td>Possessions</td>
<td>.830</td>
<td>.687, 1.002</td>
</tr>
</tbody>
</table>

(1 = undernourished, 0 = adequately nourished)

77.7% placed correctly (89.9% undernourished and 52.9% adequately nourished)
5.2. Intervention Results

5.2.1. Effect of Zinc Supplementation

All analyses were first conducted using the data from the children who participated in the zinc trial only (n = 94; 73% of the sample). In these analyses, the effect of zinc supplementation was explored and a zinc x stimulation interaction was offered in all regressions. There was no effect of zinc supplementation on child development or nutritional status or on the maternal outcomes. There was also no interaction of zinc and stimulation on any of the child or maternal outcomes (See Appendix 5 for the results of these analyses). As there was no effect of zinc and no interaction between zinc and stimulation at this time point the following analyses used the original 2 group study design (stimulation and no stimulation).

5.2.2. Loss of Study

129 children (92.8%) were tested at the end of the study period. Five children from the stimulation group and five from the control group were lost to follow up. Five of the families had moved out of the area, three mothers refused the programme (all from the stimulation group), one child was unavailable for testing due to the mother’s work schedule and for one child (from the control group) the test had to be aborted due to child’s behaviour during the test.
5.2.3. Baseline Characteristics of the Sample

*Family Characteristics*

There were no difference between the groups on crowding, sanitation, possessions, presence of the baby’s father or mother’s height, IQ, age, employment status and educational background (Table 5.7).

Table 5.7 Family characteristics on enrolment by treatment group

<table>
<thead>
<tr>
<th>Parental Characteristics</th>
<th>Intervention Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 65)</td>
<td>(n = 64)</td>
</tr>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Crowding</td>
<td>2.8 (1.4)</td>
<td>2.9 (1.8)</td>
</tr>
<tr>
<td>Sanitation</td>
<td>7.9 (3.1)</td>
<td>7.7 (3.1)</td>
</tr>
<tr>
<td>Possessions</td>
<td>5.1 (2.0)</td>
<td>5.1 (1.9)</td>
</tr>
<tr>
<td>Mother’s height</td>
<td>158.8 (6.0)</td>
<td>159.2 (5.5)</td>
</tr>
<tr>
<td>Mother’s PPVT</td>
<td>94.3 (23.3)</td>
<td>92.3 (19.6)</td>
</tr>
<tr>
<td>Mother’s age</td>
<td>26 (7.5)</td>
<td>25.8 (7.4)</td>
</tr>
<tr>
<td>Mother works (%)</td>
<td>29.2</td>
<td>32.8</td>
</tr>
<tr>
<td>Father present (%)</td>
<td>46.2</td>
<td>34.4</td>
</tr>
<tr>
<td>Mother’s education (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- completed high school</td>
<td>43.0</td>
<td>37.5</td>
</tr>
<tr>
<td>- not completed high school</td>
<td>56.9</td>
<td>62.5</td>
</tr>
<tr>
<td>Mother’s work (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- unskilled/never worked</td>
<td>35.4</td>
<td>37.5</td>
</tr>
<tr>
<td>- semi-skilled</td>
<td>44.6</td>
<td>40.6</td>
</tr>
<tr>
<td>- skilled</td>
<td>20.0</td>
<td>21.9</td>
</tr>
</tbody>
</table>

p < .05; **p < .01, ***p < .001

Sanitation (rating of water and toilet facilities combined) range 0 – 12
Possessions (number of possessions) range 0-11
Maternal Characteristics

There were no significant differences between the groups in terms of HOME observations, parenting self-esteem, social support, economic stress and domestic and community violence (Table 5.8.). There was a significant difference between the groups in partner stress (p < .05). Mothers in the control group reported significantly higher levels of partner stress than mothers in the intervention group.

Table 5.8. Maternal characteristics on enrolment by treatment group

<table>
<thead>
<tr>
<th></th>
<th>Intervention Group (n = 65)</th>
<th>Control Group (n = 64)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>HOME observations</td>
<td>16.6 (3.5)</td>
<td>16.05 (3.8)</td>
</tr>
<tr>
<td>Self-esteem</td>
<td>31.6 (8.8)</td>
<td>18.6 (5.2)</td>
</tr>
<tr>
<td>Median (Range)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Support</td>
<td>16 (5 – 20)</td>
<td>14 (1 – 20)</td>
</tr>
<tr>
<td>Economic stress</td>
<td>1 (1 – 10)</td>
<td>3 (1 – 9)</td>
</tr>
<tr>
<td>Partner stress*</td>
<td>3 (1 – 7)</td>
<td>3.5 (1 – 7)</td>
</tr>
<tr>
<td>Domestic violence</td>
<td>1 (1 – 6)</td>
<td>1 (1 – 6)</td>
</tr>
<tr>
<td>Community violence</td>
<td>2 (1 – 4)</td>
<td>2 (1 – 4)</td>
</tr>
</tbody>
</table>

*p < .05; **p < .01, ***p < .001

Child Characteristics

There were no significant differences between the groups in child age, gender or duration of time in the study (Table 5.9.)
Table 5.9. Child Characteristics on enrolment by treatment group

<table>
<thead>
<tr>
<th></th>
<th>Intervention Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 65)</td>
<td>(n = 64)</td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td></td>
</tr>
<tr>
<td>Child age</td>
<td>18.3 (4.8)</td>
<td>18.6 (5.2)</td>
</tr>
<tr>
<td>Child gender % girls</td>
<td>61.5</td>
<td>70.3</td>
</tr>
<tr>
<td>Duration in study</td>
<td>14.4 (1.1)</td>
<td>14.4 (1.0)</td>
</tr>
</tbody>
</table>

* p < .05; **p < .01, ***p < .001

5.2.4. Relationship Between Child Development and Child Age and Gender

There were no significant gender differences for global DQ or any of the subscales. There was a strong negative correlation between initial child age and initial DQ and all subscales (table 5.10.).

Table 5.10. Correlations of initial child development with child age

<table>
<thead>
<tr>
<th></th>
<th>Child age</th>
</tr>
</thead>
<tbody>
<tr>
<td>DQ</td>
<td>-.69 ***</td>
</tr>
<tr>
<td>Locomotor subscale</td>
<td>-.51 ***</td>
</tr>
<tr>
<td>Hearing and speech subscale</td>
<td>-.61 ***</td>
</tr>
<tr>
<td>Hand and eye subscale</td>
<td>-.56 ***</td>
</tr>
<tr>
<td>Performance subscale</td>
<td>-.66 ***</td>
</tr>
</tbody>
</table>

p < .05; **p < .01, ***p < .001

The decline in DQ with age is shown in figure 5.1. There is a steep decline from 10 months to approximately 24 months and then the plot levels off.
At post-test the correlations between child development and child age were no longer significant except for the hand and eye subscale which was negatively correlated with age for children receiving psychosocial stimulation ($r = -0.49$) and for non-stimulated children ($r = -0.26$).

Due to the negative relationship between child development and child age in this population, child age was used as a covariate in all analyses involving global DQ and all subscales.

5.2.5. Child Outcomes

*Anthropometry*

Table 5.11. gives the means for child anthropometry (expressed in z scores of the NCHS references) at baseline and at final evaluation. Z scores are presented in the table to facilitate comparison with other studies. At baseline and at final evaluation, there were no significant differences between the groups on weight for age, weight for height or height for age. Using repeated measures analysis of variance both groups showed
significant catch up in weight for age, weight for height and height for age over the length of the study (all \( p < .001 \)) (test, \( p < .001 \); group, not significant; group x test, not significant).

Table 5.11. Mean scores of anthropometric measures (z scores) by nutritional group at baseline and 1 year

<table>
<thead>
<tr>
<th></th>
<th>Intervention Group (n = 65)</th>
<th>Control Group (n = 64)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Weight for age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>-2.18 (.47)</td>
<td>-2.15 (.45)</td>
</tr>
<tr>
<td>After</td>
<td>-1.99 (.66)</td>
<td>-1.90 (.58)</td>
</tr>
<tr>
<td>Weight for height</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>-1.70 (.57)</td>
<td>-1.59 (.68)</td>
</tr>
<tr>
<td>After</td>
<td>-1.50 (.59)</td>
<td>-1.33 (.61)</td>
</tr>
<tr>
<td>Height for age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>-1.47 (.89)</td>
<td>-1.49 (.77)</td>
</tr>
<tr>
<td>After</td>
<td>-1.17 (.85)</td>
<td>-1.27 (.66)</td>
</tr>
</tbody>
</table>

\( p < .05; **p < .01, ***p < .001 \)

Child Development

Table 5.12. gives the unadjusted means for child development at baseline and at final evaluation. At baseline, there were no significant differences between the groups on global DQ and all subscales. At final evaluation, the intervention group had significantly higher scores than the control group in global DQ, the hearing and speech subscale, the hand and eye subscale and the performance subscale (all \( p < .001 \)). There was no significant difference between the groups on the locomotor subscale.

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Table 5.12. Unadjusted mean scores on the Griffiths test by nutritional group at baseline and after 1 year

<table>
<thead>
<tr>
<th></th>
<th>Intervention Group (n = 65)</th>
<th>Control Group (n = 64)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>DQ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>105.3 (9.3)</td>
<td>104.2 (11.0)</td>
</tr>
<tr>
<td>After***</td>
<td>99.2 (9.0)</td>
<td>91.3 (8.4)</td>
</tr>
<tr>
<td>Motor subscale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>108.7 (11.0)</td>
<td>108.5 (12.6)</td>
</tr>
<tr>
<td>After</td>
<td>104.2 (12.2)</td>
<td>102.1 (14.2)</td>
</tr>
<tr>
<td>Hearing &amp; speech subscale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>106.3 (11.7)</td>
<td>104.7 (13.7)</td>
</tr>
<tr>
<td>After***</td>
<td>100.7 (15.4)</td>
<td>89.4 (13.9)</td>
</tr>
<tr>
<td>Hand &amp; eye subscale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>106.8 (9.7)</td>
<td>104.9 (11.4)</td>
</tr>
<tr>
<td>After***</td>
<td>97.6 (10.7)</td>
<td>90.6 (8.9)</td>
</tr>
<tr>
<td>Performance subscale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>99.6 (12.7)</td>
<td>98.6 (13.1)</td>
</tr>
<tr>
<td>After***</td>
<td>94.5 (15.3)</td>
<td>83.0 (10.9)</td>
</tr>
</tbody>
</table>

p < .05; **p < .01, ***p < .001
5.2.6. Treatment Effect on Child Outcomes

Treatment Effect on Child Nutritional Status

Multilevel multiple regressions were executed with final weight, length and BMI as the dependent measures. Raw scores rather than z scores were used in the analysis (see section 4.4.1. pp: 129) and the independent variables were initial anthropometry, child age and sex, in the zinc study or not and stimulation treatment status. Partner stress, which was different between the groups at baseline was also offered.

There was no significant effect of stimulation on the nutritional status of the children. Child age was a significant covariate in the regressions on weight and length (Table 5.13.). The dichotomous variable ‘in the zinc study’ was significant in all the regressions indicating that the children who participated in the zinc trial improved less in nutritional status than the children who didn’t participate in the zinc trial. In addition, the between clinic variance was not significant in any of the regressions indicating that differences between the clinics in terms of the children’s nutritional status was negligible.

In addition, to determine if the intervention benefited certain subgroups of children more than others, a series of interaction terms were offered. The child characteristics we considered most likely to modify the effect of treatment were initial nutritional status, initial age and sex. An interaction term was computed between child stimulation status and each of these variables and the terms were entered separately into each of the regressions. All interaction terms were centred to avoid colinearity. None of the interaction terms were significant.
Table 5.13. Multilevel analysis of the effects of intervention on child nutritional status

<table>
<thead>
<tr>
<th></th>
<th>Weight Estimate (SE)</th>
<th>Length Estimate (SE)</th>
<th>Body Mass Index (BMI) Estimate (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fixed parameters</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial score</td>
<td>1.23 *** (0.10)</td>
<td>0.98 *** (0.05)</td>
<td>0.63 *** (0.07)</td>
</tr>
<tr>
<td>Age</td>
<td>-0.05 ** (0.02)</td>
<td>-0.26 *** (0.06)</td>
<td>0.03 (0.01)</td>
</tr>
<tr>
<td>Gender</td>
<td>0.00 (0.12)</td>
<td>0.21 (0.28)</td>
<td>-0.16 (0.13)</td>
</tr>
<tr>
<td>In Zinc study</td>
<td>-0.53 *** (0.14)</td>
<td>-0.69 * (0.34)</td>
<td>-0.47 ** (0.17)</td>
</tr>
<tr>
<td>Stimulation</td>
<td>-0.17 (0.15)</td>
<td>-0.00 (0.34)</td>
<td>-0.24 (0.20)</td>
</tr>
<tr>
<td><strong>Random parameters</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinic</td>
<td>0.03 (0.03)</td>
<td>0.17 (0.15)</td>
<td>0.08 (0.05)</td>
</tr>
<tr>
<td>Subject</td>
<td>0.34 *** (0.04)</td>
<td>2.01 *** (0.27)</td>
<td>0.43 *** (0.06)</td>
</tr>
</tbody>
</table>

*p < .05; **p < .01; ***p < .001
**Treatment Effect on Child Development**

To examine the treatment effect of stimulation on child development multilevel multiple regression was conducted with the final Griffiths scores as the dependent variable and initial developmental measure, child age, in the zinc study or not and stimulation treatment status as the independents. Partner stress, which was different between the groups at baseline and tester were also offered.

Stimulation had a significant effect on global DQ 7.91 points (95% confidence interval: 4.49, 11.33), the hearing and speech subscale 10.66 (5.89, 15.44), the hand and eye subscale 6.82 (3.40, 10.24) and the performance subscale 11.10 (5.48, 16.72) (Table 5.14.). There was no significant effect of stimulation on the locomotor subscale. Tester was a significant covariate for global DQ and the hand and eye subscale. In addition, the between clinic variance was not significant in any of the regressions. The clinic variance was unable to be computed for the hearing and speech subscale.

Characteristics of the child or the mother which could modify the effect of stimulation on global DQ and all subscales were also explored. The child characteristics used were initial age, initial DQ, gender and initial height and BMI. The maternal characteristics were housing, PPVT and initial depression. An interaction term was computed between child stimulation status and each of these variables. The interaction terms were then offered one at a time. Only one of the interaction terms was significant. There was a significant interaction of treatment x child age in predicting change in the hand and eye subscale (Table 5.15.) and younger children benefited most.
Table 5.14. Multilevel analysis of the effects of intervention on Griffiths developmental quotients and subscale scores.

<table>
<thead>
<tr>
<th></th>
<th>DQ</th>
<th>Locomotor</th>
<th>Hearing &amp; Speech</th>
<th>Hand &amp; Eye</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>(SE)</td>
<td>Estimate</td>
<td>(SE)</td>
<td>Estimate</td>
</tr>
<tr>
<td><strong>Fixed Parameters</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial score</td>
<td>0.60 ***</td>
<td>0.63 ***</td>
<td>0.52 ***</td>
<td>0.21 *</td>
<td>0.45 ***</td>
</tr>
<tr>
<td></td>
<td>(0.09)</td>
<td>(0.10)</td>
<td>(0.12)</td>
<td>(0.09)</td>
<td>(0.12)</td>
</tr>
<tr>
<td>Child's age</td>
<td>0.65 ***</td>
<td>1.05 ***</td>
<td>0.60</td>
<td>-0.49 *</td>
<td>0.67 *</td>
</tr>
<tr>
<td></td>
<td>(0.18)</td>
<td>(0.23)</td>
<td>(0.32)</td>
<td>(0.19)</td>
<td>(0.30)</td>
</tr>
<tr>
<td>In zinc study</td>
<td>-1.24</td>
<td>-5.22</td>
<td>0.84</td>
<td>-0.98</td>
<td>-1.54</td>
</tr>
<tr>
<td></td>
<td>(1.71)</td>
<td>(2.67)</td>
<td>(2.81)</td>
<td>(1.93)</td>
<td>(2.85)</td>
</tr>
<tr>
<td>Tester</td>
<td>-3.03 *</td>
<td></td>
<td>-3.75 *</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.52)</td>
<td></td>
<td>(1.82)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stimulation</td>
<td>7.91 ***</td>
<td>2.32</td>
<td>10.66 ***</td>
<td>6.82 ***</td>
<td>11.10 ***</td>
</tr>
<tr>
<td></td>
<td>(1.75)</td>
<td>(2.94)</td>
<td>(2.43)</td>
<td>(1.75)</td>
<td>(2.87)</td>
</tr>
<tr>
<td><strong>Random Parameters</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinic</td>
<td>4.55</td>
<td>16.30</td>
<td>1.84</td>
<td>11.14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(4.02)</td>
<td>(11.53)</td>
<td>(3.95)</td>
<td>(10.91)</td>
<td></td>
</tr>
<tr>
<td>Subject</td>
<td>51.22 ***</td>
<td>116.52 ***</td>
<td>190.96 ***</td>
<td>77.59 ***</td>
<td>150.33 ***</td>
</tr>
<tr>
<td></td>
<td>(6.76)</td>
<td>(15.40)</td>
<td>(23.79)</td>
<td>(10.19)</td>
<td>(19.82)</td>
</tr>
</tbody>
</table>

*p < .05; **p < .01; ***p < .001
Table 5.15. Multilevel analysis showing a treatment x child age interaction on the hand and eye subscale of the Griffiths test.

<table>
<thead>
<tr>
<th></th>
<th>Initial score</th>
<th>Child’s age</th>
<th>In Zinc Study</th>
<th>Tester Stim</th>
<th>Stim</th>
<th>Stim x age</th>
<th>Clinic</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimate</td>
<td>0.23 **</td>
<td>-0.49 **</td>
<td>-0.70</td>
<td>-3.74 *</td>
<td>6.73 ***</td>
<td>-0.77 *</td>
<td>1.01</td>
<td>74.99 ***</td>
</tr>
<tr>
<td>(SE)</td>
<td>(0.09)</td>
<td>(0.19)</td>
<td>(1.86)</td>
<td>(1.78)</td>
<td>(1.64)</td>
<td>(0.31)</td>
<td>(3.47)</td>
<td>(9.83)</td>
</tr>
</tbody>
</table>

*p < .05; **p < .01; ***p < .001

Figure 5.2. Means and standard errors of global DQ at baseline and final evaluation of intervened and control children adjusted for child age

![Graph showing means and standard errors of global DQ at baseline and final evaluation](image)

p < .001
Figure 5.3. Means and standard errors of the locomotor subscale at baseline and final evaluation of intervened and control children adjusted for child age.

![Graph showing locomotor subscale comparison](image)

Figure 5.4. Means and standard errors of the hearing and speech subscale at baseline and final evaluation of intervened and control children adjusted for child age.

![Graph showing hearing and speech subscale comparison](image)

P < .001
Figure 5.5. Means and standard errors of the hand and eye subscale at baseline and final evaluation of intervened and control children adjusted for child age

Figure 5.6. Means and standard errors of the performance subscale at baseline and final evaluation of intervened and control children adjusted for child age
29.7% of the children in the control group and 15.4% of the children in the intervention group were enrolled at basic school at the time of the final evaluation. The difference approached significance (p = .052). Pre-school experience has been reported to have significant effects on child development in other studies (see section 1.6.1. pp: 42) and hence we examined the effect of schooling on global DQ and each subscale after controlling for intervention status. We also examined the possibility of an interaction between school attendance and treatment.

The effect of school attendance on child development was investigated with DQ and each subscale as the dependent variable and initial developmental measure, child age, in the zinc study or not, child stimulation status and school attendance coded as a dichotomous variable (1 = yes; 0 = no) as the independents. An interaction term of school attendance x stimulation was also offered.

Attendance at basic school had significant effects on global DQ (5.38 points; 95% confidence interval (CI): 2.00, 8.76), the locomotor subscale (6.69 points; 95% CI: 1.67, 11.71), the hearing and speech subscale (7.45 points; 95% CI: 1.01, 13.89) and the hand and eye subscale (5.50 points; 95% CI: 1.38, 9.62) (Table 5.16). The interaction term of school attendance x stimulation was not significant in any of the regressions.
Table 5.16. Multilevel analysis of the effects of attendance at basic school on Griffiths developmental quotients and subscale scores.

<table>
<thead>
<tr>
<th></th>
<th>DQ</th>
<th>Locomotor</th>
<th>Hearing &amp; Speech</th>
<th>Hand &amp; Eye</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
</tr>
<tr>
<td>Fixed Parameters</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial score</td>
<td>0.57 *** (0.09)</td>
<td>0.61 *** (0.09)</td>
<td>0.48 *** (0.12)</td>
<td>0.21 * (0.09)</td>
<td>0.45 *** (0.12)</td>
</tr>
<tr>
<td>Child’s age</td>
<td>0.43 *** (0.19)</td>
<td>0.80 *** (0.24)</td>
<td>0.28 (0.34)</td>
<td>-0.66 * (0.20)</td>
<td>0.60 * (0.32)</td>
</tr>
<tr>
<td>In zinc study</td>
<td>-0.73 (1.71)</td>
<td>-3.91 (2.67)</td>
<td>2.56 (2.87)</td>
<td>-0.78 (1.82)</td>
<td>-1.18 (2.92)</td>
</tr>
<tr>
<td>Stimulation</td>
<td>8.38 *** (1.81)</td>
<td>3.13 (2.94)</td>
<td>11.65 *** (2.44)</td>
<td>7.17 *** (1.60)</td>
<td>11.32 *** (2.90)</td>
</tr>
<tr>
<td>School</td>
<td>5.38 ** (1.69)</td>
<td>6.69 ** (2.56)</td>
<td>7.45 * (3.29)</td>
<td>5.50 * (2.10)</td>
<td>1.79 (3.00)</td>
</tr>
<tr>
<td>Random Parameters</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinic</td>
<td>5.46 (4.25)</td>
<td>16.54 (11.36)</td>
<td>0.20 (3.17)</td>
<td>11.25 (10.92)</td>
<td></td>
</tr>
<tr>
<td>Subject</td>
<td>48.34 *** (6.39)</td>
<td>110.93 *** (14.69)</td>
<td>184.79 *** (22.97)</td>
<td>77.16 *** (10.09)</td>
<td>150.06 *** (19.82)</td>
</tr>
</tbody>
</table>

*p < .05; **p < .01; ***p < .001
5.2.7. Maternal Outcomes

Four mothers of children who completed the test did not complete a questionnaire (3 from the control clinics and one from the stimulation group) giving a total of 125 mothers (90% of the sample). One mother refused to answer the questionnaire and three mothers were unavailable at the time the child was tested.

At baseline, there were no significant differences between mothers in the two groups on depression, knowledge and practices (Table 5.17.). At final evaluation, mothers in the intervention group had significantly higher scores on maternal child-rearing knowledge and practices than mothers in the control group (both p < .001) and a significantly lower frequency of maternal depressive symptoms (p < .05).

Table 5.17. Mother’s child rearing knowledge and practices and frequency of depressive symptoms by nutritional group at baseline and after 1 year

<table>
<thead>
<tr>
<th></th>
<th>Intervention Group (n = 64)</th>
<th>Control Group (n = 61)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Knowledge of child rearing</td>
<td>Before 25.0 (5.5)</td>
<td>24.6 (5.9)</td>
</tr>
<tr>
<td></td>
<td>After*** 31.0 (6.5)</td>
<td>23.2 (6.1)</td>
</tr>
<tr>
<td>Child rearing practices</td>
<td>Before 27.6 (9.9)</td>
<td>25.6 (8.9)</td>
</tr>
<tr>
<td></td>
<td>After*** 31.4 (9.7)</td>
<td>24.5 (11.5)</td>
</tr>
<tr>
<td>Depression</td>
<td>Before 26 (0 - 91)</td>
<td>27 (0 - 86)</td>
</tr>
<tr>
<td></td>
<td>After* 17.5 (0 - 98)</td>
<td>29 (0 - 89)</td>
</tr>
</tbody>
</table>

p < .05; ***p < .001
5.2.8. Treatment Effect on Maternal Outcomes

The effect of stimulation on maternal child rearing knowledge and practices and frequency of depressive symptoms was investigated using multilevel multiple regressions. The independent variables were the baseline score, the variable in the zinc study or not and the child’s stimulation status. Partner stress, which was different between the groups at baseline and tester were also offered.

There was a significant positive effect of stimulation on mother’s child rearing knowledge (7.57 points; 95% confidence interval 5.74, 9.40) and practices (4.94 points; 1.43, 8.46) and a significant negative effect of stimulation on the frequency of maternal depressive symptoms (-0.96 points; -1.53, -0.41) (Table 5.18.). The between clinic variance could not be computed for the regression on depression and knowledge and the clinic variance for the practices scale was not significant.

Maternal characteristics which could modify the effect of treatment were also explored. These characteristics included the initial score of each outcome (initial depression, initial knowledge and initial practices), housing, and maternal PPVT. Interaction terms between treatment status and each of these characteristics were computed and offered separately into each of the regressions. None of the interaction terms were significant.
Table 5.18. Multilevel analysis of the effects of intervention on mother’s child rearing knowledge and practices and frequency of depressive symptoms.

<table>
<thead>
<tr>
<th></th>
<th>Depression Estimate (SE)</th>
<th>Knowledge Estimate (SE)</th>
<th>Child Rearing Practices Estimate (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fixed parameters</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial score</td>
<td>0.46 ***</td>
<td>0.65 ***</td>
<td>0.69 ***</td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.08)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>In zinc study</td>
<td>-0.77</td>
<td>-0.21</td>
<td>-0.01</td>
</tr>
<tr>
<td></td>
<td>(0.43)</td>
<td>(1.06)</td>
<td>(1.90)</td>
</tr>
<tr>
<td>Stimulation</td>
<td>-0.98 *</td>
<td>7.57 ***</td>
<td>4.94 **</td>
</tr>
<tr>
<td></td>
<td>(0.38)</td>
<td>(0.94)</td>
<td>(1.79)</td>
</tr>
<tr>
<td><strong>Random parameters</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinic</td>
<td></td>
<td></td>
<td>3.03</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(4.21)</td>
</tr>
<tr>
<td>Subject</td>
<td>4.56 ***</td>
<td>27.27 ***</td>
<td>68.95 ***</td>
</tr>
<tr>
<td></td>
<td>(0.58)</td>
<td>(3.46)</td>
<td>(9.24)</td>
</tr>
</tbody>
</table>

*p < .05; **p < .01; ***p < .001
Figure 5.7. Means and standard errors of mothers child-rearing knowledge at baseline and final evaluation for the intervention and control groups

![Knowledge Score Graph]

Intervened: n = 64
Control: n = 61

P < .001

Figure 5.8. Means and standard errors of mothers child-rearing practices at baseline and final evaluation for the intervention and control groups

![Practices Score Graph]

Intervened: n = 64
Control: n = 61

P < .001
5.2.9. Further analyses

Further analyses were conducted to examine the effect of program implementation on child and maternal outcomes and to investigate the relationship between change in child nutritional status and change in the maternal outcomes on child development.

The analyses of the treatment effect reported so far show that in this data set the between clinic variance is negligible and in certain cases it is so small that it could not be computed. Hence the use of a 2-level structure is unnecessary. In order to simplify the presentation of the results for the remaining analyses, linear multiple regressions were executed using the Statistical Package for the Social Sciences (SPSS). All analyses were repeated using the multi-level modeling program and the results were unchanged. Only the simpler, single level analyses are presented here.
5.2.10. Effect of Program Implementation Variables

The quality of the CHA, the frequency of visits and the cooperativeness of the mother were aspects of programme delivery which were hypothesized to modify the treatment effect. We hypothesized that:

- Mother-child dyads receiving more visits would benefit more from the stimulation intervention than those receiving fewer visits.
- Mothers and their children visited by CHAs rated as very good were expected to improve more than those visited by CHAs rated as being less competent.
- Children of mothers rated as being very cooperative would benefit more from the intervention than children of mothers rated as being less cooperative.

**Effect of Program Implementation on Child Development**

The mean number of home visits conducted with families in the intervention group was 32.5 (SD 11.5). The correlation between number of visits and cooperativeness of mother was $r = .03$ (p = .87).

To explore the effect of the program implementation variables on child development linear multiple regression was used. Two dummy variables of CHA quality and two dummy variables of maternal cooperation were made (very good/good = 1 and very poor/poor = 1) with average as the contrast in both cases.

Global DQ and each subscale were the dependent variables and initial developmental measure, child age and the variable in the zinc study were entered in a first step and tester, number of stimulation visits and the four dummy variables were offered stepwise in a second step.

There was no effect of the number of stimulation visits received or the quality of the CHA on child developmental outcomes (Table 5.19). Poor maternal cooperation predicted less gain in global DQ ($-6.85; 95\%$ CI: -10.81, -2.90), the hearing and speech
subscale (-8.64; 95% CI: -16.16, -1.12) and the performance subscale (-9.86; 95% CI: -17.20, -2.52). Good maternal cooperation predicted greater gain in the hand and eye subscale (5.68; 95% CI: 0.52, 10.84).

**Table 5.19. Effect of number of home visits, quality of CHA and mother’s cooperation on Griffiths DQ and subscale scores**

<table>
<thead>
<tr>
<th></th>
<th>DQ</th>
<th>Locomotor</th>
<th>Hearing &amp; Speech</th>
<th>Hand &amp; Eye</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial score</td>
<td>0.49 ***</td>
<td>0.54 ***</td>
<td>0.46 *</td>
<td>0.30 *</td>
<td>0.51 **</td>
</tr>
<tr>
<td>(0.14)</td>
<td>(0.14)</td>
<td>(0.19)</td>
<td>(0.13)</td>
<td>(0.19)</td>
<td></td>
</tr>
<tr>
<td>Child’s age</td>
<td>0.43</td>
<td>0.83 *</td>
<td>0.95 *</td>
<td>-0.75 **</td>
<td>0.51</td>
</tr>
<tr>
<td>(0.26)</td>
<td>(0.33)</td>
<td>(0.46)</td>
<td>(0.27)</td>
<td>(0.47)</td>
<td></td>
</tr>
<tr>
<td>In zinc study</td>
<td>-0.05</td>
<td>-3.96</td>
<td>1.51</td>
<td>-1.09</td>
<td>3.11</td>
</tr>
<tr>
<td>(2.15)</td>
<td>(3.15)</td>
<td>(4.25)</td>
<td>(2.56)</td>
<td>(4.05)</td>
<td></td>
</tr>
<tr>
<td>Poor maternal cooperation</td>
<td>-6.85 **</td>
<td>-0.21</td>
<td>-8.64 *</td>
<td>-9.86 **</td>
<td></td>
</tr>
<tr>
<td>(2.00)</td>
<td>(0.12)</td>
<td>(3.76)</td>
<td>(3.67)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good maternal cooperation</td>
<td>5.68 *</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2.58)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*F = 8.42 ***  F = 5.24 **  F = 3.39 *  F = 8.36 ***  F = 5.27 ***
Adj R² = 0.317  Adj R² = 0.21  Adj R² = 0.130  Adj R² = 0.315  Adj R² = 0.210

*p < .05; **p < .01; ***p < .001

**Effect of Program Implementation on Maternal outcomes**

The effect of the number of stimulation visits and quality of CHA on maternal outcomes was also determined using linear multiple regression. The dependent variables were child rearing knowledge, child rearing practices and maternal depression. Initial score and the variable in the zinc study were entered in a first step and number of stimulation visits and the two dummy variables for quality of CHA were offered stepwise.
There was a significant effect of the number of stimulation visits on frequency of maternal depressive symptoms (Table 5.20.). There was no effect of the rating of quality of CHA on any of the maternal outcomes.

Table 5.20. Effect of number of home visits and quality of CHA on mothers’ child rearing knowledge and practices and frequency of depressive symptoms

<table>
<thead>
<tr>
<th></th>
<th>Maternal depression</th>
<th>Child-rearing knowledge</th>
<th>Child rearing practices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B (Se)</td>
<td>B (Se)</td>
<td>B (Se)</td>
</tr>
<tr>
<td>Initial score</td>
<td>.63 ***</td>
<td>.56 ***</td>
<td>0.34 **</td>
</tr>
<tr>
<td></td>
<td>(0.10)</td>
<td>(0.13)</td>
<td>(0.11)</td>
</tr>
<tr>
<td>In zinc study or not</td>
<td>-0.74</td>
<td>-0.88</td>
<td>-0.96</td>
</tr>
<tr>
<td></td>
<td>(0.63)</td>
<td>(1.67)</td>
<td>(2.62)</td>
</tr>
<tr>
<td>Number of stimulation visits</td>
<td>-0.06 **</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.06)</td>
<td></td>
</tr>
<tr>
<td>F = 15.319 ***</td>
<td>F = 7.89 ***</td>
<td>F = 6.01 **</td>
<td></td>
</tr>
<tr>
<td>Adj R² = 0.405</td>
<td>Adj R² = 0.25</td>
<td>Adj R² = 0.137</td>
<td></td>
</tr>
</tbody>
</table>

*p < .05; **p < .01; ***p < .001
5.2.11. Relationship between child nutritional status and child development

Partial correlations between initial and final anthropometry and initial and final child development, controlling for child age and sex (and stimulation status for final child development), are given in Table 5.21. There was little evidence of associations between child nutritional status and child development at baseline – only one correlation was significant – performance was positively associated with length. However, at final evaluation positive associations between initial and final anthropometry and child development were found for global DQ, the motor subscale and the hand and eye subscale. Initial and final weight were correlated with all three of these outcomes, while initial and final length were correlated with the hand and eye subscale. Final length and final BMI were also correlated with scores on the locomotor subscale.

Table 5.21. Partial correlations of child anthropometry and child development scores.

<table>
<thead>
<tr>
<th></th>
<th>Initial DQ</th>
<th></th>
<th></th>
<th>Final DQ</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial</td>
<td>Initial</td>
<td>Initial</td>
<td>Final</td>
<td>Final</td>
<td>Final</td>
</tr>
<tr>
<td></td>
<td>weight</td>
<td>length</td>
<td>BMI</td>
<td>weight</td>
<td>length</td>
<td>BMI</td>
</tr>
<tr>
<td>Initial DQ</td>
<td></td>
<td></td>
<td></td>
<td>Final</td>
<td></td>
<td></td>
</tr>
<tr>
<td>motor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hearing &amp; speech</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hand &amp; eye</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>performance</td>
<td></td>
<td></td>
<td>.19 *</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final DQ</td>
<td>.27 *</td>
<td>.33 **</td>
<td></td>
<td>.27 *</td>
<td>.45 ***</td>
<td>.33 **</td>
</tr>
<tr>
<td>motor</td>
<td>.27 *</td>
<td></td>
<td>.33 **</td>
<td>.25 *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hearing &amp; speech</td>
<td></td>
<td></td>
<td>.27 *</td>
<td>.28 *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hand &amp; eye</td>
<td>.35 **</td>
<td>.27 *</td>
<td>.30 *</td>
<td>.28 *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>performance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05; **p < .01; ***p < .001
To explore the effect of change in nutritional status on change in child development, further linear multiple regression analyses were conducted. Child DQ and all subscales were the dependent variables. Initial developmental measure, child age and sex and the variable in the zinc study were entered first and then tester was offered in a second step. Finally, initial and final length, initial and final BMI and the child’s stimulation status were entered in a third step.

After controlling for initial BMI, final BMI (kg/m$^2$) was significantly and independently associated with global DQ (2.82 points; 95% CI: 0.93, 4.72), the locomotor subscale (3.78 points; 95% CI: 0.88, 6.69) and the performance subscale (3.62 points; 95% CI: 0.31, 6.93) (Table 5.22.). After controlling for initial length, final length (in cm) was significantly and independently associated with global DQ (1.04 points; 0.16, 1.92) and the locomotor subscale (1.73 points; 0.36, 3.09).
Table 5.22. Multiple linear regression of the effects of change in BMI and length on Griffiths developmental quotients and subscale scores.

<table>
<thead>
<tr>
<th></th>
<th>DQ</th>
<th>Locomotor</th>
<th>Hearing &amp; Speech</th>
<th>Hand &amp; Eye</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B (SE)</td>
<td>B (SE)</td>
<td>B (SE)</td>
<td>B (SE)</td>
<td>B (SE)</td>
</tr>
<tr>
<td><strong>Fixed parameters</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial score</td>
<td>0.63 ***</td>
<td>0.61 ***</td>
<td>0.54 ***</td>
<td>0.19 *</td>
<td>0.51 ***</td>
</tr>
<tr>
<td></td>
<td>(0.09)</td>
<td>(0.10)</td>
<td>(0.13)</td>
<td>(0.09)</td>
<td>(0.12)</td>
</tr>
<tr>
<td>Child’s age</td>
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<td>1.11 ***</td>
<td>0.64</td>
<td>-0.98 *</td>
<td>1.32 *</td>
</tr>
<tr>
<td></td>
<td>(0.37)</td>
<td>(0.24)</td>
<td>(0.66)</td>
<td>(0.42)</td>
<td>(0.64)</td>
</tr>
<tr>
<td>Gender</td>
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<td>-1.84</td>
<td>3.02</td>
<td>3.29</td>
<td>-1.07</td>
</tr>
<tr>
<td></td>
<td>(1.41)</td>
<td>(2.22)</td>
<td>(2.76)</td>
<td>(1.71)</td>
<td>(2.45)</td>
</tr>
<tr>
<td>In Zinc</td>
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<td>1.87</td>
<td>-0.61</td>
<td>1.48</td>
</tr>
<tr>
<td>study</td>
<td>(1.58)</td>
<td>(2.33)</td>
<td>(3.09)</td>
<td>(1.93)</td>
<td>(2.78)</td>
</tr>
<tr>
<td>Initial BMI</td>
<td>-0.55</td>
<td>-1.36</td>
<td>0.77</td>
<td>1.74</td>
<td>-1.49</td>
</tr>
<tr>
<td></td>
<td>(1.14)</td>
<td>(1.74)</td>
<td>(2.20)</td>
<td>(1.38)</td>
<td>(1.98)</td>
</tr>
<tr>
<td>Final BMI</td>
<td>2.82 **</td>
<td>3.78 *</td>
<td>1.14</td>
<td>1.33</td>
<td>3.62 *</td>
</tr>
<tr>
<td></td>
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<td>(1.47)</td>
<td>(1.85)</td>
<td>(1.16)</td>
<td>(1.62)</td>
</tr>
<tr>
<td>Initial length</td>
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<td>-1.43</td>
<td>-0.33</td>
<td>0.26</td>
<td>-1.44</td>
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<tr>
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<td>(0.87)</td>
<td>(1.08)</td>
<td>(0.68)</td>
<td>(0.97)</td>
</tr>
<tr>
<td>Final length</td>
<td>1.04 *</td>
<td>1.73 *</td>
<td>0.52</td>
<td>0.58</td>
<td>1.24</td>
</tr>
<tr>
<td></td>
<td>(.45)</td>
<td>(.67)</td>
<td>(.87)</td>
<td>(.54)</td>
<td>(.77)</td>
</tr>
<tr>
<td>Stimulation</td>
<td>8.14 ***</td>
<td>2.88</td>
<td>11.15 ***</td>
<td>6.93 ***</td>
<td>11.94 ***</td>
</tr>
<tr>
<td></td>
<td>(1.29)</td>
<td>(2.00)</td>
<td>(2.51)</td>
<td>(1.57)</td>
<td>(2.24)</td>
</tr>
<tr>
<td>**F = 11.92 *** F = 6.85 *** F = 4.77 *** F = 7.12 *** F = 5.86 *****</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adj R² = .43 Adj R² = .29 Adj R² = .21 Adj R² = .30 Adj R² = .26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05; **p < .01; ***p < .001
5.2.12. Relationship between child DQ and maternal outcomes

Partial correlations between initial and final maternal child-rearing knowledge and practices and frequency of depressive symptoms and initial and final global DQ controlling for age (and stimulation status for final DQ) are shown in Table 5.23.

At baseline, there was no association between mother's knowledge of child rearing and frequency of depressive symptoms on child DQ. However, a positive association was evident between mother's child-rearing practices at baseline and initial DQ (p < .01) indicating that child development was better in children of mothers who reported playing more with their child. None of these initial maternal characteristics were associated with final child development scores. At post-test, higher scores on global DQ were associated with higher scores on child rearing knowledge (p < .001) and practices (p < .01) indicating that child DQ was higher for children of mothers who reported playing more with their child and for mothers who demonstrated increased knowledge of appropriate activities and teaching strategies.

Table 5.23. Partial correlations between maternal characteristics and child DQ

<table>
<thead>
<tr>
<th></th>
<th>Initial</th>
<th>Initial</th>
<th>Initial</th>
<th>Final</th>
<th>Final</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>knowledge</td>
<td>practices</td>
<td>depression</td>
<td>knowledge</td>
<td>practices</td>
<td>depression</td>
</tr>
<tr>
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<td>.26 **</td>
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<tr>
<td>Final DQ</td>
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<td>.34 ***</td>
<td>.27 **</td>
<td></td>
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</tbody>
</table>

p < .05; **p < .01, ***p < .001

Further linear multiple regression analyses were executed to determine the effects of change in maternal characteristics on change in development. Child DQ was the dependent variable and the initial developmental measure and age were entered in a first step, tester was offered in a second step and initial and final score for the maternal characteristic and stimulation status were entered in a third step. Separate regressions
were conducted to explore the effect of change in mother’s knowledge, practices and depression on change on global DQ.

After controlling for initial score, final scores on mother’s child rearing practices and final scores on the frequency of maternal depressive symptoms did not have a significant effect on child global DQ (Tables 5.24 & 5.25). Final scores on mother’s child rearing knowledge did however have a significant effect on global DQ after controlling for initial knowledge (0.31 points; 95% confidence interval 0.05, 0.57) (Table 5.26.).

**Table 5.24. Effect of change in frequency of maternal depressive symptoms on child DQ**

<table>
<thead>
<tr>
<th>Initial score</th>
<th>Child age</th>
<th>In zinc study</th>
<th>Initial depression</th>
<th>Final depression</th>
<th>Stimulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B (SE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.57 ***</td>
<td>0.61 **</td>
<td>-1.73</td>
<td>0.23</td>
<td>-0.29</td>
<td>7.63 ***</td>
</tr>
<tr>
<td>(0.10)</td>
<td>(0.19)</td>
<td>(1.58)</td>
<td>(0.31)</td>
<td>(0.32)</td>
<td>(1.76)</td>
</tr>
</tbody>
</table>

p < .05; **p < .01, ***p < .001  

F = 12.40 *** Adj R² = .37

**Table 5.25. Effect of change in maternal child rearing practices on child DQ**

<table>
<thead>
<tr>
<th>Initial score</th>
<th>Child age</th>
<th>In zinc study</th>
<th>Initial practices</th>
<th>Final practices</th>
<th>Stimulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B (SE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.59 ***</td>
<td>0.65 **</td>
<td>-1.64</td>
<td>-0.10</td>
<td>0.11</td>
<td>7.06 ***</td>
</tr>
<tr>
<td>(0.10)</td>
<td>(0.19)</td>
<td>(1.58)</td>
<td>(0.09)</td>
<td>(0.08)</td>
<td>(1.43)</td>
</tr>
</tbody>
</table>

p < .05; **p < .01, ***p < .001  

F = 13.35 *** Adj R² = .37
Table 5.26. Effect of change in maternal child-rearing knowledge on child DQ

<table>
<thead>
<tr>
<th></th>
<th>Initial score</th>
<th>Child age</th>
<th>In zinc study</th>
<th>Initial knowledge</th>
<th>Final knowledge</th>
<th>Stimulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B (SE)</td>
<td>0.58 ***</td>
<td>0.64 **</td>
<td>-1.49 (1.53)</td>
<td>-0.24 (0.15)</td>
<td>0.31 * (0.13)</td>
<td>5.29 **</td>
</tr>
</tbody>
</table>

p < .05; **p < .01, ***p < .001  

F = 14.41 *** Adj R² = .39
Chapter 6: Discussion

This chapter contains the following sections:

- A brief description of the main findings from the case-control study and the treatment trial
- A discussion of the validity of the study
- A discussion of the results of the case control study
- A discussion of the results of the randomised controlled trial
- A description of future plans

6.1. Description of Main Findings

6.1.1. Case Control Study
I located no previous study which reported that mothers of currently undernourished children in developing countries have poorer psychosocial function than mothers of adequately nourished children. In this study we found that mothers of undernourished children in Jamaica had lower parenting-self esteem, higher levels of economic stress and a higher frequency of depressive symptoms than mothers of adequately nourished children. Maternal psychosocial function was mainly explained by socio-economic factors. Parenting self-esteem was an independent predictor of the level of stimulation in the home and hence maternal psychosocial function was related to the quality of parenting provided by the mother.

6.1.2. Randomised Controlled Trial
In the randomised controlled trial, we demonstrated that using government health aides working within government health centres to deliver a home-based, parent-focused, early intervention programme can be effective in improving child development, maternal child-rearing knowledge and practices and reducing the frequency of maternal depressive symptoms in a sample of undernourished children and their mothers.
Previous studies in Jamaica with both undernourished and disadvantaged children have shown that a low cost, home based intervention can improve child development and these findings were repeated. However, in this study, government health aides employed by the government and working full-time in government health centres conducted the home visits and the intervention was thus integrated into existing health and nutrition services for undernourished children. In addition, benefits were shown for the mothers. These benefits were improved parenting knowledge and practices and a lower frequency of depressive symptoms. To my knowledge, this is the first study to report on the effects of a psychosocial stimulation or parenting education programme on the mental health of mothers of undernourished children.

We also found that using groups as a method of service delivery was not feasible in this setting due to low attendance by the mothers. Home visiting proved a more feasible and effective option.

6.2. Validity of the Treatment Trial

Cook & Campbell (1979) describe four types of validity pertinent to experimental studies and the threats which may undermine the validity of a study. Their classifications of validity include statistical conclusion validity, construct validity of putative causes and effects, internal validity and external validity. Their framework will be utilized here to discuss the validity of the treatment trial.

6.2.1. Statistical Conclusion Validity

Statistical conclusion validity involves minimizing the likelihood of Type I (false positive) or Type II (false negative) errors and hence ensuring that a valid inference is made as to whether a relationship is present or not.

Power of the study

The first consideration is the power of the study. In a study with insufficient power, Type II errors are more likely as the sample size is too small to show an effect. In this study, 64 children in each group allowed us to detect a difference of half a standard
deviation for each outcome at a power of 80% and a significance level of $p < .05$. Half a standard deviation was used to calculate the power of the study as it is generally considered to represent a functionally significant effect in social science research. Significant effects were found for seven out of eleven main outcomes and the power was probably sufficient in this study to detect the main effects. However, none of the interaction terms were significant, indicating that no subgroups within the sample benefited more than others. However, we can not rule out lack of power as an explanation for this result.

Measurement reliability
The reliability of the measurements used in the study also influences the likelihood of Type II errors as unreliable measurements inflate the standard errors of the estimates. Hulley et al (2001) describe three main sources of random error when making measurements: observer variability, instrument variability and subject variability and discusses strategies for enhancing measurement precision. These strategies include standardizing the measurement methods, training the testers and refining the instruments. These strategies were used for all measurements in the study and will be discussed briefly below.

The Griffiths test for measuring child development has very clear guidelines concerning administration and scoring which have been extended by the research team in Jamaica to maximize consistency within and between testers. In addition, the testers were trained until high reliabilities were achieved.

For the anthropometric measurements, written guidelines were provided for the research assistant responsible for measuring the children, training was given until satisfactory reliability was achieved and a digital scale was used to weigh the children to minimize observer error.

The maternal outcomes were assessed using interviewer administered questionnaires. These questionnaires were written clearly and instructions given about how the
questions should be asked and the probes to be used where necessary. As with the above measurements, interviewers were trained until satisfactory reliability was achieved.

In addition, ongoing quality control of between 5 to 10% of all of the measurements ensured that observer variability was kept to a minimum. Subject variability is more difficult to control. However, the children were not tested if they were recovering from illness and measurements were scheduled for a time convenient for the mothers. The depression questionnaire asked if the past week had been representative of most weeks and if a major event had occurred (for example, a death in the family), the interview was to be rescheduled. However, this did not occur over the study period.

Two types of reliability were reported for all measurements in this study: interobserver reliability and test-retest reliability.

Interobserver reliabilities were high (> .90) for all measurements used in the study both at baseline and in ongoing quality control. In addition, tester was offered as a covariate in the regressions on child development and the maternal outcomes. Despite the high interobserver reliabilities, tester was a significant covariate for global DQ and for the hand and eye subscale suggesting that although the child's competencies were scored reliably between the testers, the presentation of the test differed. However, equivalent numbers of children in the intervention and control group were assigned to each tester and tester was offered as a covariate in all analyses.

Good test-retest reliabilities over a two week period for the maternal questionnaires were also achieved. The test-retest reliabilities over a one year period for global DQ, maternal knowledge and practices and maternal depression were moderate (between r = 0.49 and r = 0.61).

Reliability of treatment implementation
The treatment involved parenting education for the mothers and psychosocial stimulation for the children. The aim of the treatment was to demonstrate age
appropriate child stimulation activities to the mothers which they would continue during the week. Government community health aides (CHAs) delivered the programme. In such a programme it is very difficult to standardize the treatment implementation. Although clear guidelines were given to the CHAs concerning how to conduct each home visit and monthly supervision in the field was provided for each CHA, the nature of the home visits varied. This was partly a function of the degree of effort the CHAs were willing to expend and their interest in the programme. In addition, the nature of the visit depended to some degree on the cooperation of the mother and maternal compliance in conducting the activities on a regular basis would also inevitably differ across persons and across time. This lack of reliability in the treatment implementation would inflate the error variance and increase the likelihood of a Type II error. However, significant differences were found between the intervention and control groups on child development outcomes and maternal outcomes and hence this lack of reliability in the way the treatment was implemented did not affect the statistical conclusion validity (although it may act as a threat to external validity as the lack of reliability in treatment implementation may prevent the results being replicated in future projects).

**Use of appropriate statistical tests**

The use of appropriate statistical tests is obviously an important factor in statistical conclusion validity. In this study, the health centres were randomized to intervention or control rather than the individual children. It is possible that the children and mothers attending each health centre are more similar with each other than with children from other centres. If no account was taken of this clustering, the standard errors of the regression coefficients may be underestimated, increasing the likelihood of a Type I error (Rasbash et al, 2000). Hence in analyzing the data, a multi-level modeling programme was used (MLWin) which allows the clinic variance to be controlled. In this sample, the clinic variance was negligible in all the regressions and hence a two level structure was not strictly necessary. Results were similar when the data were analysed using multiple regression without multi-level modelling.
In addition to using appropriate statistical tests, the assumptions of the statistical tests must be met. All data were checked for normality and transformed where necessary. The assumptions of equality of variance and linear relationships between variables were checked on the data. In addition, the distribution of the residuals were checked for all the regressions.

When multiple statistical tests are used there is an increased likelihood of falsely concluding that a statistical relationship exists when it does not. Cook & Campbell name this the 'error rate problem'. In the treatment trial there were eleven main outcomes - global DQ and four subscales, three measures of nutritional status (weight, length and BMI), two measures of parenting (child rearing knowledge and practices) and one measure of maternal psychosocial function (depression) and seven of these were significant. Less than one significant result would be expected by chance alone and hence the error rate problem is probably not pertinent to the main outcomes of this study.

6.2.2. Construct Validity of Putative Causes and Effects
Construct validity of putative causes and effects refers to the conceptual validity of the causal relationship and the possibility of confounding.

Validity of Measurements
The Griffiths Scales of Mental Development were used as a measure of the child's development across several domains. This test has not been standardized for use in Jamaica and the uneven profile of scores across the different subscales shows that poor Jamaican children behave differently to the norming population of the test. However, the test was used to assess the relative positions of the intervention versus the control group and no attempt was made to interpret the absolute level of the scores or compare these scores with other populations or the population used to standardise the test.

The Griffiths test has been used in several studies previously in Jamaica and has been shown to have reasonable stability over time. In addition it shows significant concurrent correlation with the Stanford Binet and the Picture Peabody Test (PPVT) (Grantham-McGregor et al, 1987) and was shown to be predictive of later IQ and school
achievement (Grantham-McGregor et al, 1994). We therefore considered the Griffiths test to be an appropriate measure of child development to evaluate this study.

The maternal outcomes in this study were measured through interviewer administered questionnaires.

The practices subscale was heavily based on the maternal report items from the Home Observations for the Measurement of the Environment (HOME) Scale (Caldwell & Bradley, 1979). It is unfortunate that we were unable to include the items based on observation as home visits were not logistically or financially feasible at the time of final evaluation. The HOME scale has been shown to be associated with levels of child development in many studies (for example, Korenman et al, 1995; Brooks-Gunn, 1993) and was found to be predictive of change in child development in a sample of Jamaican preschoolers (Grantham-McGregor et al, 1991). The scale had a good internal reliability (Chronbach’s alpha = 0.8) and was an independent predictor of child development at baseline in this study.

Maternal depression was measured using a scale based on the Centre for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977). All of the constructs included in the original instrument were retained except one - loss of appetite - for which we were unable to design an appropriate question when piloting. The test-retest over a 2 week period and the test-retest over 1 year were similar to test-retests reported for the original scale (Radloff, 1977). Furthermore, the internal reliability was high (Chronbach’s alpha = 0.90) and the measure correlated with parenting self-esteem, social support, stressors and socio-economic variables in a theoretically sensible way. However, we had no check of the scale's criterion-related validity using a clinical examination of maternal depression. The questionnaire measures the frequency of depressive symptoms and in the original scale there is a cut-off which represents clinical depression. However, we did not use cut-off points due to difficulties in transferring across cultures and the scale was analysed as a continuous variable.
Maternal knowledge of child-rearing was a questionnaire designed especially for this study but some questions from previous questionnaires used for surveys of child-rearing in Jamaica were adopted. The questionnaire assessed the mothers’ knowledge of age appropriate activities she could do with her child and her knowledge of how to stimulate her child’s development. Change in maternal knowledge predicted change in child development over the course of the study which provides some evidence of the validity of the scale.

Interaction of different treatments
Another threat to construct validity of putative causes and effects occurs when subjects receive more than one treatment as the effect may be due to the combination of treatments rather than to one of the treatments alone. As a large proportion of the children in this study also participated in a zinc supplementation trial, this threat is pertinent to the interpretation of the results.

In analyzing the outcomes from the stimulation trial (assessed six months after the completion of the zinc trial), we first conducted the analysis using children who participated in the zinc trial only and no benefits of zinc were found for child development or growth. In addition, there was no significant interaction between zinc and stimulation on any of the outcomes. There remains the possibility that there was insufficient power to detect significant effects thus increasing the likelihood of a Type II error. However, the results were not even approaching significance (p < .1) which gives us more confidence in concluding that the effect of zinc supplementation did not bias the results of the effect of psychosocial stimulation on child growth and development.

Hypothesis guessing and evaluation apprehension
Subject bias is introduced when the subjects guess the hypothesis and behave as they think they are expected to and/or when they try to portray themselves in the most favourable manner. Subject bias is probably not a threat in terms of the child outcomes in the study as the children were too young to be affected by this. The maternal questionnaires were open to this threat especially the practices questionnaire as the intervention had a strong emphasis on encouraging mothers to play more with their child. The knowledge questionnaire was possibly less affected by the threat of subject
bias as it evaluates what the mothers know rather than what they believe or feel or how they behave.

**Experimenter expectancies**

Observer bias is introduced when the observer expects the experimental group to perform more favourably on a test or questionnaire. In this study, the testers and interviewers were blind to the treatment status of the children and hence this bias was minimized.

**6.2.3. Internal Validity**

Cook & Campbell (1979) use the term internal validity to refer to the degree of confidence with which we can infer that the relationship between treatment and outcome is causal. Many of the threats to internal validity can be ruled out through the use of randomization with pre and post testing including threats which result from maturation, familiarity with a test, instrumentation, statistical regression and selection of subjects.

**Randomisation**

In this study, health centres were stratified by size and randomly assigned to treatment and control and pre and post testing of all measurements for both groups of children was conducted. The randomization procedure was affected however by the expansion of the study area to include St Catherine. The study area was expanded as too few children were identified in the parish of Kingston & St Andrew and by chance a greater number of controls than cases had been recruited. Therefore, three intervention and one control centre were randomly assigned in St. Catherine. This resulted in significantly more control subjects living in the Kingston area than intervention subjects (90.6% versus 70.8%; p < .01). However, only 2 out of 38 t-tests exploring differences between subjects from St Catherine and Kingston on baseline characteristics were significant – mothers in Kingston were significantly taller than mothers in St Catherine (p < .01) and mothers in St Catherine scored significantly higher on the HOME observations than mothers in Kingston (p < .05). These differences are probably due to chance. However, to ensure that these differences did not alter the
treatment effect these variables were offered into the regressions on child development and nutritional status and maternal outcomes and the results remained unchanged.

The randomization was successful in producing equivalent groups on the baseline measurements – the only significant difference between intervention and control groups was in the level of partner stress reported by the mother and this variable was offered in all regressions to determine the treatment effect and was not significant.

Attrition

Internal validity is also threatened by attrition especially differential attrition as the intervention and control groups are no longer comparable and the treatment effect may be due to characteristics of the subjects who remain in the study (for example, high motivation) rather than due to the treatment. In this study five children from each group were not tested at the final evaluation point and the attrition was 7.2%. This is very low compared with the reports of home visiting programmes in the US where it is not unusual for attrition to be as high as 50%.

Other threats to internal validity

Other threats to internal validity are diffusion or imitation of treatment, compensatory equalization of treatments, compensatory rivalry by respondents in the control group and resentful demoralization of respondents in the control group. As the health centres serve discrete geographical areas, these threats are unlikely. In addition, the CHAs in the control clinics received no information or training about the intervention until the project was completed.

6.2.4. External Validity

External validity refers to the generalisability of the results. One important feature of external validity is the representativeness of the sample to the target population.

Our sampling frame included all nutrition clinics in Kingston & St Andrew and urban St Catherine except for 2 clinics, in more rural areas, which were excluded due to their distance from the university. Only 7 children who met the inclusion criteria were not
enrolled in the study as their mothers refused consent (5% of the sample). The sample was therefore reasonably representative at baseline of undernourished children enrolled in nutrition clinic in the metropolitan area of Kingston and St Catherine. Attrition from the study was 7.2% and there were no significant differences on the baseline characteristics between families that did and did not take part in the final evaluation suggesting that the representativeness of the sample remained adequate.

We can therefore be reasonably confident that the results can be generalized to undernourished children enrolled in nutrition clinics in the health centres of urban areas of Kingston and St Catherine. This study was an assessment of the efficacy of a public health intervention, involving testing an intervention which has proven clinical efficacy in tightly controlled research settings, in a public health setting under controlled conditions (de Zoysa et al, 1998). Whether the intervention would remain effective as a large-scale public health programme is still to be determined.

There was no placebo for the control group in this study. Hence we do not know if the gains in child and maternal outcomes are a result of the psychosocial stimulation activities and parenting programme or are a result of the social support provided to these families through the home visits. The possibility of the latter explanation in illustrated by the Avon Premature Infant Project (1998) in which a home based developmental education project was compared to home based social support intervention involving supportive counseling and a non-visited control group. There were no significant differences between the groups receiving the developmental education programme and the social support programme on child development as measured by the Griffiths Scales and both groups showed a significant benefit over the controls. However, in a previous study in Jamaica, in which psycho-social stimulation was shown to benefit stunted children, the families in the control group were visited weekly by a community health aide (Grantham-McGregor et al, 1991), albeit no structured programme of support was offered as in the Avon project above.
6.3. Validity of Case-Control Study

The validity of a case-control study refers to the extent to which the associations identified are true and not due to measurement or sampling bias or to lack of power or to chance.

6.3.1. Measurements

A discussion of the validity of the HOME scale and the depression questionnaire was included in the previous section. Other questionnaires used were parenting self-esteem and chronic stressors. Both questionnaires had good test-retest reliabilities, good internal consistency and were correlated with other variables in a theoretically sensible way. In addition, the interviewers were blind to the nutritional group of the children. This was possible in most cases due to the wide age range of the children enrolled.

It was unfortunate that resources did not permit us to administer developmental tests with the adequately nourished children as this restricted our ability to look for associations with children's development.

6.3.2. Sample Selection

The undernourished children were identified from the nutrition clinic records in government health centres in the parishes of Kingston & St Andrew and St Catherine. Identifying the subjects from within the health centres could introduce a bias as undernourished children who had not been identified through the health centre would be excluded. However, all children who had been referred to nutrition clinic were sampled regardless of whether they actually attended the nutrition clinic or not. Hence the sample was not biased towards those who attended regularly. Furthermore, the majority of mothers do take their infants and young children to the health centre as complete immunization is a requirement for attendance at basic school and also mothers who do not attend are visited at home by health care staff and encouraged to attend. Hence although there is a possibility that the undernourished children enrolled were not wholly representative of all undernourished children, it is likely that the majority of undernourished children are identified in these urban areas of Jamaica.

The controls were selected from the same health centres and were matched for age (in
two age bands) and for sex with every other undernourished child. They were identified from the maternal-child health clinics. A potential bias could be that the controls were recruited within the clinic only and hence only attendees were sampled. However, all of the undernourished children had attended clinic in the last 3 months and as the undernourished children are expected to attend more often than is required for routine well-baby care it is more likely that they would miss some clinic appointments.

6.3.3. Power and the error rate problem
We enrolled twice as many cases as controls. Sixty five subjects in one group and 130 in the other would give 90% power to detect a difference of half a standard deviation on all measurements at a significance level of $p < .05$. There were 71 controls and 139 cases in the study and hence the power was sufficient to detect significant differences. The error rate problem was discussed previously and refers to the likelihood that some associations are due to chance when many statistical tests are used. Although many comparisons were made in the case-control study the number of significant associations was greater than would be expected by chance alone. For example, 25 comparisons were made and 14 were significant. Only one significant association would be expected by chance alone.

6.3.4. Classification of Undernutrition
Weight for age was used to define the nutritional status of the groups. This is not an ideal measure of nutritional status as it represents a mixture of height for age and weight for height, which may have different aetiologies. Low weight for height (wasting) is thought to represent recent nutritional experiences whereas height for age (stunting) reflects undernutrition for a longer period of time. We recruited on weight for age despite the inherent limitations of this measure because this is the classification used by the nutrition clinics and as this study involved integration into service, the nutritional criteria needs to be based on what happens in practice. The original study protocol involved enrolling children who were below -2 standard deviations weight for age of the NCHS references. However, insufficient numbers of children were available and hence the enrolment criteria was changed to below -1.5 standard deviations. Hence the criteria for enrolment was mild undernutrition. However, all children had been below -2 standard deviations weight for age (moderate undernutrition) in the last three months.
6.4. Discussion of the Results of the Case-Control Study

6.4.1. Socio-economic variables
Differences favouring the mothers of adequately nourished children were found for maternal verbal IQ, a rating of sanitation facilities and the number of possessions in the household and the skill level of maternal occupation. It was not surprising that the mothers of undernourished children scored lower on these socio-economic variables than mothers of adequately nourished children as this is a relatively consistent finding across studies in different cultures (Grantham-McGregor, 1984; Graves 1976, 1978; Galler & Ramsey, 1985; Vella et al, 1994). The mothers of undernourished children were also less likely to live with the baby’s father which is also consistent other studies in the literature (Goodall, 1979; Dixon et al, 1982).

6.4.2. Psychosocial function, stressors and social support
Mothers of undernourished children reported more depressive symptoms, had lower parenting self-esteem and more economic stress than mothers whose children were adequately nourished. There is to my knowledge, no previous study which has shown a significant difference in psychosocial function in mothers of children who are concurrently undernourished although one study have been suggestive (Begin et al, 1999) and two studies have reported higher levels of depression in mothers of previously undernourished (Salt et al, 1988) or iron-deficient anaemic children (DeAndraca et al, 1990). There was no difference between the groups in the availability of social support and in stressors relating to the mother’s partner and domestic and community violence.

Maternal depressive symptoms were explained to some extent by environmental factors including economic stress, lack of social support, poor relationship with their partner and domestic violence. Low parenting self-esteem was also explained by economic stress, domestic violence and relationship with partner as well as by the skill level of the mother’s work.
6.4.3. Stimulation in the home

The mothers of undernourished children in this study also provided a less stimulating home environment for their children than the control group and this has been shown in other studies (Cravioto & Delcardie, 1976; Sheffer et al, 1981). Parenting self-esteem and partner stress were independent predictors of the level of stimulation in the home indicating that the psychosocial status of the mother and the level of daily stressors experienced affected the quality of the child's home environment. Hence, there was an independent association between maternal psychosocial function and stimulation in the home. Maternal IQ was the only other variable to contribute to home stimulation.

6.4.4. Relationship between psychosocial function, stimulation provided in the home and undernutrition

We had hypothesized that stimulation in the home may mediate the relationship of psychosocial function with nutritional status. However, neither mothers' psychosocial function nor home stimulation were associated with being undernourished once environmental factors were taken into account. The environmental factors predicting nutritional group were economic stress, low skill level of occupation, fewer possessions and absence of the baby's father which are all indicators of poverty. These results are similar to those reported by Salt et al (1988) who also found that the differences in the level of depression amongst the mothers in their sample in Barbados were explained by socio-economic factors. The mothers in the current study all came from poor neighbourhoods and this would have limited the variance in economic status. However, indicators of poverty were still the most powerful predictors of nutritional status.

Mother's height was also independently associated with nutritional group and in this population is likely to reflect the intergenerational cycle of poverty, that is, women who are stunted in early childhood due to undernutrition are more likely to be poorer and have children who are undernourished. Valenzuela (1997), in a study in Chile, also found significantly poorer nutritional status (indexed by height and weight) among
mothers of underweight toddlers than among mothers of toddlers with no nutritional deficiency. Furthermore, maternal height and weight predicted the level of maternal sensitivity which in turn predicted attachment status. Valenzuela concludes that the:

"association between maternal weight ..... and infant malnutrition suggests that biological vulnerability in the caregiver may potentiate and increase existing psychosocial and environmental risks associated with failure to provide adequate caregiving in socioeconomically disadvantaged contexts."

Valenzuela 1997, pp: 853

6.4.5. Implications of the results

Little attention has been paid to the psychosocial function of mothers of undernourished children. Maternal depression has been found to be associated with a poorer quality of maternal-child interaction (Lovejoy et al, 2000) and age typical behaviour problems in children (Teti & Gelfand, 1990). In addition, it is a risk factor for poor cognitive function (Kurstjens & Wolke, 2001) and poor school achievement (Salt et al, 1988). The increased frequency of depressive symptoms amongst the mothers of undernourished children in this sample indicates the presence of another risk factor in the lives of children who are already suffering from multiple risk including poverty, absence of a father figure, lower maternal IQ and undernutrition. Multiple risk is a potent predictor of children’s low intellectual functioning.

Good parenting self-esteem has been reported to act as a buffer and is particularly important for parents who experience chronic stressors. The increased poverty experienced by the mothers of undernourished children and the increased levels of economic stress as compared to the adequately nourished children are stressors in the lives of these mothers and having a child diagnosed with undernutrition is likely to be another. The lower levels of self-esteem amongst mothers of undernourished children is thus likely to have important implications for their parenting ability. One measure of parenting quality is the level of stimulation provided for the child in the home and indeed in this sample, self esteem was an independent predictor of home stimulation.
Unfortunately we had no measure of child development for the adequately nourished children in this study but it is possible that maternal psychosocial function was associated with poorer cognitive function amongst the two groups combined although there were no correlations between parenting self esteem or maternal depression and child development amongst the undernourished children only.

The HOME scale was an independent predictor of global DQ at baseline for the undernourished children and as parenting self esteem was independently associated with the HOME, parenting self-esteem may have an indirect effect on child development in this sample. The association between home stimulation and development has been demonstrated previously in other studies in Jamaica (Grantham-McGregor et al, 1991) and other developing countries (Grantham-McGregor et al, 1996).

Most of the undernourished children in this study were only mildly to moderately undernourished. In countries where poverty and malnutrition are more severe, poor psychosocial function is probably a greater problem and could have a serious impact on children's development.

6.4.6. Summary
Mothers of undernourished children had more depressive symptoms and poorer self esteem than mothers of adequately nourished children. These differences were explained by more stressful environments. They also provided a less stimulating home environment for their children that was partly explained by poor self esteem. It is thus important that when treating undernourished children, attention is paid to the psychosocial status of the mother and to potential stressors in their environment.
6.5. Discussion of the Results of the Treatment Trial

6.5.1. Child Development

There was a significant decline in global DQ and all subscales for children in both the intervention and control group over the course of the study period. This decline in developmental quotient over the first 2 years of life has been reported for children living in poverty in several countries including the US (Breitmeyer and Ramey, 1986), Indonesia (Pollitt, 2000), Colombia (Waber et al, 1981) and Jamaica (Walker & Grantham-McGregor, 1990). However, the decline in developmental quotient was significantly less for children in the intervention group. The experimental group also declined significantly less than the controls on the hearing and speech subscale, the hand and eye subscale and the performance subscale.

The benefits of psycho-social stimulation on child development were substantial. The standardized effect sizes (effect size / standard deviation) were 0.94 for global DQ, 0.77 for the hearing and speech subscale, 0.77 for the hand and eye subscale and 1.02 for the performance subscale. Effect sizes of above 0.7 are generally classified as large and are almost certainly functionally, as well as statistically, significant.

These results are high when compared with the literature from the US. The average gain from child-focused centre-based early intervention is half a standard deviation and the gains from parent focused interventions have generally been more modest. However, the results are comparable with previous randomized controlled trials in Jamaica as demonstrated in Figure 6.1. which shows the standardized effect sizes of the benefits of psychosocial stimulation on child development after 1 year of intervention in two previous Jamaican studies and the current study. The two previous studies are the study with stunted children (Grantham-McGregor et al, 1991) (Table 1.2., pp: 33) and the community study with disadvantaged children (Powell & Grantham-McGregor, 1989) (Table 1.4., pp: 62).
The reasons for greater gains from an early intervention programme in Jamaica as compared to programmes in the US are unclear. Possibly the mothers and children served are more disadvantaged than the samples in US studies. Olds & Kitzman (1993) suggest that for home visiting programs to be successful the parents need to believe that they are vulnerable and the home visitors need to believe that the program can be effective. We could hypothesise that these conditions are more likely to be met in an environment in which few services are available to address the needs of vulnerable families. Hence there may be more possibility of improvement with intervention in Jamaica where there are few safety nets for those living in poverty.

There was no benefit of psychosocial stimulation on the locomotor subscale. This is concordant with many other early childhood education programmes. For example, of all the parent-focused early childhood education programs reviewed in sections 1.3.4 and 1.7. only two showed benefits to motor development (Grantham-McGregor et al, 1991; Field et al, 1982) while eighteen studies showed benefits to mental development.
6.5.2. Growth

The nutritional status of children in both the intervention and the control group significantly improved over the year of the study as indexed by weight for age, height for age and weight for height. However, between pre and post test, the majority of the children crossed 24 months (105 children, 81.4% of the sample) and at this age the NCHS references become discontinuous (Dibley et al, 1987). The discontinuity is such that the prevalence of low weight for height and low height for age drops at age 2 years and hence the catch up in weight for height and height for age may be an artifact of the references rather than to changes in the nutritional status of the children. Examination of the reference charts indicate this is most marked for the height for age index and the weight for height index is less affected. The disjunction in the Z-score curve of the weight for age index at age 2 years results in an increase in the prevalence of low weight for age and hence the result of a significant catch up in weight for age is likely to be reliable.

It was not surprising that there was no effect of psychosocial stimulation on the nutritional status of the children. Previous studies in Jamaica have also found no benefits of stimulation on growth (Walker et al 1991; Grantham-McGregor et al, 1994, Powell 1990) and there is no study to my knowledge that demonstrated a concurrent effect of psychosocial stimulation on the growth of undernourished children although in the Bogota study a significant effect was found 3 years after the end of the intervention (Super et al, 1990).

Parent-focused early education programmes starting at birth with disadvantaged families (Field et al, 1982) and with families with pre-term, low birth weight infants (Scarr-Salapatek & Williams, 1973; Field et al, 1980) have however shown a significant benefit of parent-focused early stimulation programmes on infant growth. It is possible that the first few months of life represent a time of heightened responsivity when psycho-social stimulation is most likely to impact on infant nutritional status.
6.5.3. Maternal Outcomes

**Parenting outcomes**
The intervention involved discussing parenting messages with the mothers and demonstrating age appropriate activities with books and toys. In addition, opportunities for integrating learning experiences into daily routines were regularly discussed with the mothers. Play materials were left in the home at each visit and the mother was encouraged to continue the activities with her child, preferably on a daily basis, throughout the week. It was therefore not surprising that mothers in the intervention group had higher scores on a questionnaire assessing knowledge of child rearing (standardized effect size = 1.24) and reported playing more with their children (standardized effect size = 0.43) than mothers in the control group.

**Psychosocial function**
We had no hypothesis regarding the effect of the intervention on maternal depression as the literature provides no clear evidence of the effect of parent-focused programs on the mother’s mental health. However, significant benefits of intervention were found with mothers in the intervention reporting fewer depressive symptoms than mothers in the control group (standardized effect size = 0.46). The intervention involved home visits by a community health aide who focused on child stimulation activities. One aspect of the programme was also to build the mother’s self-esteem and to support her in her caregiving role. In addition, there were often concerns and troubles faced by the mothers in the study and these would be regularly discussed with the community health aide. Regular visits by a person ready to listen to worries and concerns who is also supportive and provides praise and encouragement is probably the mechanism through which the reduction in depression was achieved.

6.5.4. Mechanism
Three aspects of program implementation were examined to determine if they were related to amount of improvement: the number of visits received the quality of the CHA
and the cooperativeness of the mother. We also examined if the reported improvement in mother’s knowledge and practices was related to change in child development.

**Number of visits**

The number of visits received by the mother and child had no effect on change in child development within the group of children receiving the intervention. This is surprising as we hypothesized that children receiving more visits would benefit more than children receiving fewer visits. It may be that there were too few children receiving few visits thus reducing the power to show an effect, for example, only 8 children in the intervention group received less than a third of the visits. Alternatively, there may be a threshold of visits required below which the intervention becomes ineffective rather than a dose-response relationship. However, previous studies designed to investigate the effect of different frequencies (Powell & Grantham-McGregor, 1989) or different duration of early intervention (McKay et al, 1978) have demonstrated that increased intensity or duration of intervention leads to increased gains in child development which suggests that the latter explanation, though plausible, is less likely.

There was also no effect of number of visits on mother’s child-rearing knowledge and practices. However, a significant effect of number of visits was found for change in the frequency of maternal depressive symptoms with a higher number of visits predicting a reduction in the frequency of depressive symptoms. This provides further evidence that it was the social support element of the intervention that affected maternal depression.

**Quality of Community Health Aide (CHA)**

The quality of the CHA as rated by the two program supervisors had no effect on change in child development or change in maternal outcomes. We could speculate several reasons for this. Firstly, the quality of the CHA as evaluated by the program supervisors may not represent ‘quality’ as perceived by the mothers themselves. Alternatively, as the curriculum is very clear, structured and directive even CHAs rated as poor were able to deliver the activities, messages and exercises satisfactorily. In addition, great care was taken in designing the initial training for the CHAs to ensure a measure of understanding.
of the curriculum and how it was to be implemented and there was ongoing supervision in the field. It may be that all CHAs were of adequate quality to produce benefits for the mothers and children.

Cooperativeness of mother

The level of cooperation of the mother was a significant predictor of change in global DQ, the hearing and speech subscale, the hand and eye subscale and the performance subscale. Hence the involvement of the mother in the programme had an impact on how much the child benefited in terms of their development. Maternal cooperation and involvement has been an important element determining program success in other projects (Osofsky et al, 1988; Liaw et al, 1995). Although this result makes theoretical sense it should be interpreted with caution as the rating is open to bias. The CHA rated the cooperation of the mother but judgment may have been influenced by the CHAs perception of the progress the child was making. The level of maternal cooperation may also be a proxy for some measure of psychosocial risk in the sample. However, there was no evidence of this as it was not correlated with any of the socio-economic variables or indices of psychosocial function, social support and stressors collected at baseline.

Effect of Maternal Characteristics on Child Development

Change in maternal knowledge of child rearing over the year of the study predicted change in child development. However, change in maternal practices which relates to the frequency the mother engages her child in a variety of stimulatory experiences did not predict change in child DQ. This suggests that the amount of time the mother spends playing with her child is less important than the appropriateness of the activities done. In Jamaica, there is an early emphasis on teaching the alphabet and formal ‘school-like’ tasks to children as young as one or two. In addition, there is little emphasis placed on following the child’s lead or using praise and verbal feedback to encourage a child to do a task. The intervention increased the mother’s awareness of how to engage her child in learning activities and what activities are age appropriate for her child. This knowledge was translated into developmental gains for the child.
6.5.5. Who Benefits most?

Previous studies have shown that children with lower ability and children from more disadvantaged backgrounds benefit more from early education interventions than their more able and more affluent peers. Similarly there is some evidence that parent-focused interventions benefit those mothers at highest psychosocial risk. However, in the current study, there was limited evidence of certain subgroups of mothers and children benefiting more from the intervention than others. The only significant interaction term was between treatment and child age on the hand and eye subscale and the younger children benefited most. This lack of evidence of increased effectiveness for more vulnerable subgroups may reflect, in part, the homogeneity of the population enrolled in the study. The sample was recruited from poor and predominantly urban neighbourhoods and all children were undernourished at baseline. It could be that the intervention is equally effective for all undernourished children living in poverty in Jamaica. Alternatively, as the sample size was relatively small there was a very small number of values in the extreme range, (for example, only 2 children had a DQ below 85 points at baseline), and these small numbers would reduce the power to detect interactions.

6.5.6. Use of Paraprofessionals

In this study, paraprofessionals (community health aides) conducted the home visiting. Olds & Kitzman (1993) in a review of home visiting concluded that programmes staffed by professionals are more likely to be effective than those staffed by paraprofessionals. However, they drew these conclusions based largely on programmes in the US. In low and middle income countries the cost of using professionals for early intervention programmes would be prohibitively high. Previous studies in Jamaica have used paraprofessionals and the results have been consistently good. In fact, in an early Jamaican study (Grantham-McGregor & Desai, 1975), the home visitors were a nurse and a pediatrician and the overall gain for the intervention group for global DQ was 13 points (standardized effect size: 1.08) – remarkably similar to the three Jamaican studies represented in figure 6.1. which had standardized effect sizes on global DQ of 0.95, 1.16 and 0.94.
Paraprofessionals have also been used successfully in early intervention programs in other countries. For example, in the study in South Africa (Cooper et al, 2002) described in section 1.8.2. (pp: 71) visits by community workers had a significant benefit to maternal sensitivity to her infant. Furthermore, the intervention was well-received by the mothers who reported feeling supported by the community workers and reported that the community worker had enhanced their ability to care for their baby.

The community health aides in this study were familiar with the communities and were generally welcomed by the families they visited. Only two mothers dropped out of the study due to lack of interest and the study was not plagued with the problems of retaining families as reported in much of the home visiting literature in the US. The majority of the CHAs had a good understanding of the intervention and were capable of conducting visits competently. Only one CHA out of a total of eighteen who participated in a week-long training session was considered to lack the understanding and competence necessary to conduct the intervention effectively. In addition, all of the CHAs had very good interpersonal skills and developed a supportive relationship with the mothers they visited.

6.5.7. Service Delivery Strategy

We hypothesized that using group sessions would be the most feasible and efficient method of delivering a service of parent focused early childhood education to undernourished children and their mothers within a primary health care setting in Jamaica. Previous studies have demonstrated the efficacy of parent focused early childhood education interventions using a group format on child development and behaviour (Andrews et al, 1982), mother’s parenting skills (Slaughter 1983; Minde et al, 1980) and maternal psychosocial function (Barlow et al, 2002). However, we were not successful in motivating the mothers to attend on a regular basis. There was a variety of reasons for the poor attendance including hidden costs, distance, family responsibilities, violence in the community and the strict protocols for dress and behaviour enforced by
the security personnel in the health centres. Low attendance at group sessions has also been reported in other studies (Andrews et al, 1982; IHDP, 1990; Baker et al, 1999). Home visiting on the other hand was an acceptable form of service delivery for the mothers in the study. It was not uncommon for mothers to make special arrangements to facilitate their participation in the intervention. For example, some of the mothers who were in employment would arrange to meet with the CHA out of work hours or at lunchtime. In addition, mothers in the intervention group who sent their child to basic school would either arrange for visits when the child returned home or would collect the child early on the day the CHA was visiting. The intervention itself was also acceptable to most of the mothers. The majority of families in Jamaica place great value on education and schooling and hence the mothers are generally receptive to a programme which helps to prepare their child for entry into school.

6.5.8. Relationship Between Change in Development and Change in Nutritional Status

Linear growth independently predicted change in global DQ and the locomotor subscale. Gains in body mass index (BMI) predicted change in global DQ, the locomotor subscale and the performance subscale. There was no effect of child growth on the hearing and speech and the hand and eye subscale. These results are interesting for their comparability with supplementation studies. Studies involving supplementing pregnant and lactating women (Joos et al, 1983) and young children (Pollitt et al, 1993; Husaini et al, 1991; Grantham-McGregor et al, 1991) have all reported benefits to the child's motor development and a meta-analysis by Pollitt & Oh (1994) showed that supplementary feeding consistently produced gains in motor performance in the 1st and 2nd years of life. There is some evidence that motor development is affected first and then the benefits spread to other areas of development. For example, in the study with stunted children in Jamaica, supplementation primarily benefited the locomotor subscale in the 1st year, and in the 2nd year of the study benefits of supplementation were evident on the performance subscale (Grantham-McGregor et al, 1991). In two other studies, benefits of supplementation were first found for
locomotor and manipulative activities and later gains were found in other areas (Klein, 1979; Mora et al, 1979). Pollitt et al (2000b) proposes that the increase in motor skills enables the child to engage in

"developmentally meaningful actions"

which in turn promote mental development.

In this study, growth of the children produced similar benefits to development as supplementation in previous studies.

6.5.9. Attendance at basic school

Attendance at basic school was found to have independent effects on child development in terms of overall DQ, the motor subscale, the hearing and speech subscale and the hand and eye subscale. Only scores on the performance subscale showed no significant gains of attendance at basic school. This benefit of basic school supports the evidence from other studies which have demonstrated that pre-school experience produces benefits for children's development (Zoritch et al, 2002; Barnett, 1998). However, this effect needs to be interpreted with caution as the families who sent their children to school may differ in some important ways from those who did not send their children to school. Correlations with baseline measurements provided no evidence of this as only one out of twenty four correlations with school attendance were significant and this is likely due to chance.

6.5.10. Integrating into Government Service

Previous studies involving psychosocial stimulation for undernourished children in Jamaica have been highly controlled research studies with full control over the home visitors who were employed specifically to the programme. In this study, community health aides were not employed to the study but were employed by the government and had full time jobs working in the health centres. We were expecting them to do additional work to their usual duties. In addition, no incentives were paid for conducting the intervention except for a small gift at the end of the study period. Hence, the research
team had little control over the home visitors and their level of cooperation depended on a variety of factors including:

- support for the programme from the Public Health Nurse in the health centres
- the burden of work within the health centre
- the CHAs own personal attributes and motivation and
- the level of goodwill between the individual CHAs and the programme supervisor

There were several problems resulting from utilising government staff and the consequent lack of control. For example, one CHA refused outright to continue the home visiting without a financial incentive. Amongst the remaining CHAs, the level of interest and motivation in the programme varied.

As the research team had no authority over the CHAs their continued cooperation depended on goodwill and a strong interpersonal relationship between the supervisors and the CHAs. Hence, at the beginning of the programme, much time was invested in building a good relationship between each CHA and the primary supervisor (the author). The counseling skills of using genuineness, positive regard and empathy were used to ensure a relationship was built which was characterised by trust and openness. Active listening skills were used to enable the CHAs to express their thoughts, feelings and beliefs openly and honestly and the author took a personal interest in the CHAs both as people and as professionals. Furthermore, the author gave her home telephone number to each CHA and they were encouraged to phone at any time.

In addition, throughout the intervention, the author sought to build on the strengths of each CHA in implementing the visits rather than focusing on weaknesses and areas that needed improvement. This technique helped to build the CHA’s self-esteem and self-efficacy and was more appropriate for ensuring continued compliance in completing the visits than more authoritarian methods. The feedback given to the CHAs on their visits was mostly positive and was specific (that is, the CHA was given details about what was good about the interaction) and immediate (that is, feedback was given immediately
after the visit). Any negative feedback was given tentatively but more often the
techniques of 'modeling' and 'shaping' were used. Modeling involves utilising the
desired behaviours oneself whilst shaping describes giving positive feedback on
behaviours which are approximating the desired behaviour. For example, if a CHA was
inhibited about conducting the activities with a child, the supervisor would model the
technique by conducting the one of the activities herself and would give positive
feedback when the CHA made some effort to engage the child in a playful activity or a
song.

The quality of visit planning and record keeping also varied amongst the CHAs. The
intervention required prior planning for each visit for each family as well as recording
each child's progress during the visit. A minority of the CHAs needed constant
reminders to prepare their visits in advance and to ensure they carried the appropriate
toys. Reminders were also required as to the importance of recording the child's level of
competence and enjoyment of the activities introduced. It was not possible to monitor
the planning and recording of the home visits on a weekly basis as was the case in
previous studies. Meetings between each CHA and the program supervisor were planned
to take place fortnightly but this was not always possible and it was not unusual for the
CHAs to be supervised at monthly intervals only.

The main difficulty experienced was that the home visits were not conducted weekly and
a few of the CHAs needed a great deal of encouragement before they would undertake
the visits. There are several possible explanations why home visits were not completed
and these are discussed below:
1. Perhaps the primary reason was that the programme was seen to be an extra and not
   a part of the CHAs regular duties. This was the result of several factors:
   
   ➢ Firstly, only one CHAs from each health centre was trained and hence the
     programme was not an integral part of all the community health aides' duties.
   ➢ Secondly, within each health centre, the CHAs have responsibility for
conducting home visits within one of the catchment areas. However, in the current programme, the trained CHA had responsibility for visiting all the enrolled families and this entailed traveling from district to district and the use of unreliable and crowded public transport. This not only led to demotivation in some of the CHAs but also reinforced the 'distinctness' of the programme.

➢ Thirdly, the home visits were not included on the weekly tally sheet of activities submitted to the Ministry of Health. The tally sheet is a document which records all the activities conducted within each health centre on a weekly basis. The Ministry of Health uses these tally sheets to supervise the running of the health centres and to monitor public health interventions. The fact that this programme was not included on the tally sheet meant that it was not viewed as a core program within the health centre service by the Public Health Nurses and by the CHAs.

2. Staff shortages in some health centers resulted in the CHA designated to do the home visiting programme being unable to be released.

3. Community violence, gang warfare, road blocks and curfews are sporadic occurrences in many of the areas served by the health centres in the study. No home visiting is done by health centre staff when the violence erupts and throughout the aftermath when the community is tense and volatile.

4. The immunization coverage within Jamaica had fallen to well below the target levels when the study was operating. The Ministry of Health thus instituted a large immunization campaign to tackle this problem which increased the workload of the CHAs and made it more difficult for them to conduct the home visits.

5. The programme was not a priority for the public health nurses in charge of the health centres. This was a result of insufficient collaboration with the nurses in planning
and running the programme and they did not have responsibility for any aspect of the programme except releasing one of their health aides for up to two half days a week.

6.6. Future Plans

The study provided valuable evidence of the efficacy of psycho-stimulation within a public health setting and has been instrumental in persuading the Ministry of Health to scale-up the intervention. There are plans to introduce the programme on a larger scale to all health centres in three parishes of Jamaica – Kingston & St Andrew, St Catherine and St Thomas. In addition, the target population will be widened to include other vulnerable groups although the criteria for eligibility into the programme is still to be negotiated. The programme will be the overall responsibility of a senior Public Health Nurse who will be trained over a two year period by a counterpart funded by UNICEF, Jamaica.

There were many challenges in implementing this study and by overcoming these challenges we learned the problems with the approach we were using and devised strategies to improve the programme in the next phase. Very early in the programme we discovered that group sessions as a method of service delivery was not appropriate in this population. Home visiting is a method of service delivery which is acceptable to the mothers and which can be integrated into existing service. However, for the programme to be sustainable the following changes would need to be made:

1. All the CHAs in each participating health centre would need to be trained and have responsibility for visiting high risk children in their own area. This would solve the issue of aides visiting outside of their designated district and would also ensure that the programme was understood to be a normal part of a CHA's duties.

2. The Ministry of Health should ensure that the early stimulation programme is included on the tally sheets completed weekly by each health centre. This would give official recognition to the importance of the programme.
3. The Public Health nurses need to be more active participants in the project with more input into the planning, implementation and evaluation aspects of the programme. In the future the public health nurses will be responsible for identifying the children at risk in their area and for monitoring the CHAs visit planning and recording.

4. For the programme to increase in scale the curriculum will need to be simplified to involve less toys and more activities that can be integrated into household activities. In addition given the high labour costs in Jamaica it may prove more cost effective to produce some of the materials commercially rather than to use self-made toys.
6.7. Conclusions

In this study, we showed that mothers of undernourished children in Jamaica have lower parenting self-esteem and a higher frequency of depressive symptoms than mothers of adequately nourished children. They are also more socially and economically disadvantaged. These are all risk factors for poor quality of parenting and for poor child development and behaviour. Undernutrition is also a risk factor for poor child development and behaviour. The presence of multiple risk in the lives of young children has been shown in other studies to have long term deleterious effects on child IQ, school achievement, school progress and social and emotional functioning. It is thus important to provide appropriate and effective interventions for these families which facilitate child development and provide benefits for the mothers.

This study utilized a randomized controlled study design to demonstrate that it is possible to integrate a parent-focused early intervention program into existing health and nutrition services for undernourished children in an urban area of Jamaica. This integrated service, using community health aides employed by the government, produced benefits to child development of similar magnitude to previous Jamaican studies using paraprofessional staff employed to the programme. The intervention also benefited mother’s child rearing knowledge and practices and maternal mental health. In addition, the study provided valuable evidence as regards the most feasible method of service delivery. Group sessions were not appropriate in this population as illustrated by the very low attendance by the mothers. In contrast, home visiting was acceptable to the mothers and few mothers opted out of the programme over the year of the study.
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Winick M, Meyer K, Harris R (1975) Malnutrition and environmental enrichment by


Appendix 6

Domains tested in a selection of child development tests
## Child Development Tests

<table>
<thead>
<tr>
<th>Test</th>
<th>Component Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batelle Developmental Inventory</td>
<td>Personal-social domain&lt;br&gt;Adaptive domain (behaviour)&lt;br&gt;Motor domain&lt;br&gt;Communication domain (language)&lt;br&gt;Cognitive domain</td>
</tr>
<tr>
<td>Bayley Scales of Mental Development</td>
<td>Mental development (cognition)&lt;br&gt;Psychomotor development</td>
</tr>
<tr>
<td>Denver Developmental Screening Test - Revised</td>
<td>Personal social abilities&lt;br&gt;Fine-motor adaptive abilities&lt;br&gt;Language abilities&lt;br&gt;Gross motor abilities</td>
</tr>
<tr>
<td>Developmental Profile (DP II)</td>
<td>Physical scale (motor)&lt;br&gt;Self-help scale&lt;br&gt;Social scale (social)&lt;br&gt;Academic scale (cognition)&lt;br&gt;Communication scale (language)</td>
</tr>
<tr>
<td>Gessell Development Schedule</td>
<td>Cognitive&lt;br&gt;Motor&lt;br&gt;Personal social&lt;br&gt;Language</td>
</tr>
<tr>
<td>Griffiths Scales of Child Development</td>
<td>Locomotor (gross motor)&lt;br&gt;Hearing and speech (language)&lt;br&gt;Hand and eye (fine motor)&lt;br&gt;Performance (cognition / problem solving)&lt;br&gt;Personal social (social / emotional)</td>
</tr>
<tr>
<td>Kaufman Assessment Battery for Children – Mental Processing Scales</td>
<td>Sequential processing (cognition)&lt;br&gt;Simultaneous processing (cognition)</td>
</tr>
<tr>
<td>McCarthy Scales of Children’s Abilities</td>
<td>Verbal Scale (language)&lt;br&gt;Perceptual performance scale (cognition)&lt;br&gt;Quantitative scale (cognition)&lt;br&gt;Motor scale&lt;br&gt;General cognitive&lt;br&gt;Memory (cognition)</td>
</tr>
<tr>
<td>Slosson Intelligence Test - Revised</td>
<td>Vocabulary (language)&lt;br&gt;General information&lt;br&gt;Similarity and differences (cognition)&lt;br&gt;Comprehension (language)&lt;br&gt;Quantitive (cognition)&lt;br&gt;Auditory memory (cognition)</td>
</tr>
<tr>
<td>Stanford Binet</td>
<td>Verbal reasoning (cognition)&lt;br&gt;Quantitative reasoning (cognition)&lt;br&gt;Abstract / visual reasoning (cognition)&lt;br&gt;Short term memory (cognition)</td>
</tr>
<tr>
<td>Weschler Scale of Children Abilities – Revised (WISC-R)</td>
<td>Verbal subscale (language)&lt;br&gt;Performance subscale (cognition)</td>
</tr>
<tr>
<td>Wide Range Achievement Test (WRAT)</td>
<td>Reading (school achievement)&lt;br&gt;Spelling (school achievement)&lt;br&gt;Arithmetic (school achievement)</td>
</tr>
<tr>
<td>Woodcock-Johnson Psychoeducational battery</td>
<td>Cognitive battery&lt;br&gt;Achievement battery (school achievement)</td>
</tr>
</tbody>
</table>
Appendix 1

Consent forms used in the study
CONSENT FORM

December 9, 1999

Dear Mother:

We are from the UWI and together with the Ministry of Health we are carrying out a study for a year to look at how young children grow and develop.

If you take part:

1) We will ask you to take your son/daughter to the clinic at the beginning and end of the study when we will measure his/her development using toys and games.

2) We will come to your home and ask you some questions about yourself and your child. The information you give us will be strictly confidential.

3) We will weigh and measure your child every 3 months.

If you need more information please contact Dr Christine Powell 927-1884, 977-6251

I agree to participate

__________________________  ___________________________  _______________________
Mother’s name                Signature                  Date

__________________________  ___________________________  _______________________
Witness’ name                Signature                  Date

__________________________
Child’s name

Epidemiology Research Unit
U.W.I., Mona, Kingston 7, Jamaica
Tel: (876) 927-1884
Fax: (876) 977-0632
Email: tmru@infochan.com

Sickle Cell Unit
U.W.I., Mona, Kingston 7, Jamaica
Tel: (876) 927-2471
Fax: (876) 927-2984
Email: scu@uwimona.edu.jm

Tropical Metabolism Research Unit
U.W.I., Mona, Kingston 7, Jamaica
Tel: (876) 927-1884 / 977-6251
Fax: (876) 977-0632
Email: tmru@infochan.com

Chronic Disease Research Centre
U.W.I., "Avalon", Jemmottts Lane, Bridgetown, St. Michael, Barbados
Tel: (246) 426-6416 / 426-8096
Fax: (246) 426-8406
Email: cdrc@uwichill.edu.bb
CONSENT FORM

December 9, 1999

Dear Mother:

We are from the UWI and together with the Ministry of Health we are carrying out a study for a year to look at how young children grow and develop.

If you take part:

1) We will ask you to take your son/daughter to the clinic at the beginning and end of the study when we will measure his/her development using toys and games.

2) We will come to your home and ask you some questions about yourself and your child. The information you give us will be strictly confidential.

3) We will weigh and measure your child every 3 months.

4) A health aide from the health centre will visit you at home every week and show you some games and activities you can do with your child.

If you need more information please contact Dr Christine Powell 927-1884, 977-6251

I agree to participate

_________________________  ___________________________  __________________
Mother's name  Signature  Date

_________________________  ___________________________  __________________
Witness' name  Signature  Date

_________________________
Child's name
Appendix 2

Questionnaires administered to mothers in the study at baseline and at final evaluation

Responses which were coded as positive for open questions on knowledge questionnaire
Early Childhood Stimulation Project
ERU, UWI / MOH

Name of Interviewer: _______________  Date: __________
Name of Child: _______________  ID: __________
Name of Mother: _______________

Gender of child: Male  Female

This questionnaire is to be given to the female caretaker who is the mother if she is there for 4 nights of the week or more. If the mother is there for less than 4 nights, the female who takes care of the child is the respondent.

Caregiver Information
Relationship to the child?: __________________________
Respondent’s age in complete years: __________________________
If not mother, how often does the child see mother?: __________________________

Do you work?  Yes  No
What kind of work? (if not working when last worked) __________________________

Mother’s occupation
1. Unskilled  4. Highly skilled
2. Semi-skilled  5. Professional
3. Skilled  6. Never worked

What was the last school you went to? __________________________
What was the highest grade completed in school? __________________________
Did you do any exams?  Yes  No  Name of exams: __________
Mother’s education:  
1. Less than Grade V  
2. Grade V-IX, Jnr. Sec/All age - no exams  
3. Grade V-IX, Secondary exams - incomplete  
4. High school - complete but did not pass O levels/CXC  

Are you married?  
Yes  
No  
If no, are you living with your boyfriend  
Yes  
No  

Marital status:  
1. Single  
2. Cohabiting  
3. Married  
4. Divorce/Widow  
5. Separated  
6. Visiting friend  

Does the baby’s father live here?  
Yes  
No  
If no, does he visit?  
Yes  
No  
If yes, how often?  
______________________________  

How many children does the mother have?  
__________________________  

Birth order of this baby  
__________________________
Parenting Questionnaire

Note to Interviewer: All ambiguous responses to be probed carefully, by saying 'Tell me more' or 'Can you explain that'. Additional probes are given as indicated.

Now I want to ask you some questions about being a parent and taking care of young children.

1. Tell me some of the things you think a good parent does with her young child, a child aged 3 or younger  
   Do not probe

2. Will too much love and attention spoil a child?  
   agree completely   agree a little bit   disagree a little bit   disagree completely

3. Do you need to hit children when they are rude or they will grow up bad?  
   agree completely   agree a little bit   disagree a little bit   disagree completely

4. Is it important that a busy mother spend plenty timechatting with little babies?  
   agree completely   agree a little bit   disagree a little bit   disagree completely

5. Is it important that parents start teaching children to write letters and know their abc before they are 3 years old?  
   agree completely   agree a little bit   disagree a little bit   disagree completely

6. Once a child can feed himself, can he be left alone to eat?  
   agree completely   agree a little bit   disagree a little bit   disagree completely
7. If you praise a child too much will it make him swell-headed (boosy, show off)?

agree completely  agree a little bit  disagree a little bit  disagree completely

8. When teaching a young child (a child less than 3) should parents make the child sit still and listen carefully?

agree completely  agree a little bit  disagree a little bit  disagree completely

9. Is it important that a busy mother spend plenty time **playing** with young children?

agree completely  agree a little bit  disagree a little bit  disagree completely

10. Is it important that parents start teaching children to do little sums before they are 3 years old?

agree completely  agree a little bit  disagree a little bit  disagree completely

11. When teaching a young child, which is the most important:
   
   To praise him when he is right  or
   To point out when he is wrong

12. At mealtimes, if a child doesn’t eat much, what should a parent do?  **Probe once**

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

13. Can you tell me some ways a parent can help a young child learn to talk and understand what you say  **Probe once**

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
14. What sort of thing would you teach a child under 3 years with: *Probe each item once unless respondent says no or nothing*

a book: ____________________________________________________________
___________________________________________________________

a doll: ____________________________________________________________

pencil and paper: _____________________________________________________

15. Is there anything you would teach a child under 3 years when: *Probe each item once unless respondent says no or nothing*

Dressing him: _________________________________________________________
___________________________________________________________

Out walking with him: ________________________________________________
___________________________________________________________

Bathing him: _________________________________________________________

16. When a parent is teaching a young child to do something and the child is more interested in something else, what should the parent do?

*If respondent suggests a positive action to bring child back to task, record and probe: 'What should you do if he is still not interested in what you're teaching?'
Feelings Questionnaire

Sometimes we feel sad and unhappy and other times we feel good. I now want to ask you some questions about how you've been feeling this past week.

1. Did anything unusual happen that bothered you during the last week? Yes  No
   If yes, what
   _______________________________________

Explain about the past week e.g. today is Monday so I want you to tell me how you have been feeling in the past week, from last Monday until this morning.

During the past week (e.g. from last Monday until today):

2. How many nights did you not sleep well and toss and turn?
   ___________ nights

3. How many days did you feel so down that nothing could cheer you up?
   ___________ days

Sometimes we feel that we're no good and other times we feel that we're just as good as everyone else.

4. How many days, in the last, week did you feel that you were just as good as other people?
   ___________ days

5. How many days did you feel depressed?
   ___________ days

6. How many days did you get tired for no reason?
   ___________ days

7. How many days did you think your life had been a failure?
   ___________ days
8. How many days did you feel that no-one cares about you?
   _____________ days

9. How many days did you feel happy?
   _____________ days

10. How many days did you enjoy yourself?
    _____________ days

11. How many days did you feel like crying?
    _____________ days

12. How many days did you feel that people don’t like you?
    _____________ days

13. How many days could you not get going and didn’t feel like moving?
    _____________ days

14. How many days did you think that the future looks bad?
    _____________ days

15. How many days did you feel that life is just a whole heap of disappointments?
    _____________ days

16. How many days did you feel that life is just one problem after another problem?
    _____________ days
Parenting Questionnaire 2
I now want to ask you some more questions about being a parent and how you feel about being a parent.
I want you to tell me if you agree or disagree with what I say - like before tell me if you agree completely, agree a little bit, disagree a little bit or disagree completely.

1. If I could start all over again I would not have children
agree completely    agree a little bit    disagree a little bit    disagree completely

2. Being a parent is hard
agree completely    agree a little bit    disagree a little bit    disagree completely

3. Being a parent makes me worried
agree completely    agree a little bit    disagree a little bit    disagree completely

4. My child does plenty things that make me feel good
agree completely    agree a little bit    disagree a little bit    disagree completely

5. Being a parent is frustrating
agree completely    agree a little bit    disagree a little bit    disagree completely

6. It takes a long time for parents to really understand their child
agree completely    agree a little bit    disagree a little bit    disagree completely

7. At times I think I am no good as a parent
agree completely    agree a little bit    disagree a little bit    disagree completely

There are times when mothers find it hard being a parent and other times it may be easier. I want to ask you some questions about how you think you are at being a parent.

Introduce the ladder to the parents. Point on ladder as you explain.
I want you to tell me if you think you are:
Not so good at what I ask
You have some trouble
You're okay at what I ask or
You're good at it

8. When you think of yourself as a parent, do you think you are
a good parent    okay/ average    have some trouble    not so good
Mothers are better at some things than others. I want to ask you questions about how good you are at doing different things with your child.

*Use ladder: give option not so good first, then have some trouble, then okay, then good.*

9. How good are you at doing the right things when your child is sick
   - good
   - okay/average
   - have some trouble
   - not so good

10. How good are you at showing love and affection to your child
    - good
    - okay/average
    - have some trouble
    - not so good

11. How good are you at getting your child to behave good
    - good
    - okay/average
    - have some trouble
    - not so good

12. How good are you at feeding your child the right kinds of food
    - good
    - okay/average
    - have some trouble
    - not so good

13. How good are you at helping your child learn to talk
    - good
    - okay/average
    - have some trouble
    - not so good

14. How good are you at planning new things for your child to do
    - good
    - okay/average
    - have some trouble
    - not so good

15. How good are you at staying calm and not getting angry with your child
    - good
    - okay/average
    - have some trouble
    - not so good

16. How good are you at teaching your child things?
    - good
    - okay/average
    - have some trouble
    - not so good

17. How good are you at understanding your child, what he wants and what he needs?
    - good
    - okay/average
    - have some trouble
    - not so good

18. How good are you at coping with your child when he’s rude
    - good
    - okay/average
    - have some trouble
    - not so good
Stress Questionnaire

I'm now going to ask you about things that happen in your community and in your home and yard.

1. About how many people were hurt by violence in your community, for example, shot or stabbed in the last month? _____________________________________________

2. Do you worry about the violence in your community and how it affects you and your children's safety? Yes No If yes, do you worry all the time a lot of the time sometimes not so much

3. Is there any fighting or serious quarrels in your house? Yes No If yes, how often: a lot just sometimes not so much

4. In the past month, has anyone in your home hit or hurt you or your children? Yes No If yes, how many times? _______________________________

5. Do you ever worry that you or your children will be hurt by people in your house? Yes No If yes, do you worry all the time a lot of the time sometimes not so much

6. During the past week, was there a time when there was no food in the house? Yes No If yes, how many times? _______________________________

7. Do you worry about not being able to get enough food for you and the children. Yes No If yes, do you worry all the time a lot of the time sometimes not so much

8. Do you have money coming into the house every week or every month? Yes No

9. Do you ever worry that you won't have enough money for food and other basic needs? Yes No If yes, do you worry all the time a lot of the time sometimes not so much
10. Does your boyfriend / husband or baby father support you and give you money?
   Yes  No
   If yes, Regularly (every week/month) or not regularly

10b. How well do you get along? very well okay not so good

10c. Does he give you any worries? Yes  No  If yes, does he give you worries
   all the time a lot of the time sometimes not so much

Social Support
I'm now going to ask you some questions about people who help you when you need help.

1. Do you have someone you can trust to look after the children good when you need to go out?
   Yes  No  If yes, how often is there someone you can trust to look after your children
   A little of the time Sometimes Most of the time Always

2. Do you have someone to help with the housework if you were sick?
   Yes  No  If yes, how often is there someone to help with the housework if you’re sick
   A little of the time Sometimes Most of the time Always

3. Do you have someone to take you to the doctor if you were sick?
   Yes  No  If yes, how often is there someone to take you to the doctor when you’re sick?
   A little of the time Sometimes Most of the time Always

4. Do you have someone you can trust to share your most private worries and fears with?
   Yes  No  If yes, how often can you share your most private worries and fears with someone?
   A little of the time Sometimes Most of the time Always

5. Do you have someone who understands your problems?
   Yes  No  If yes, how often does someone understand your problems?
   A little of the time Sometimes Most of the time Always
Parenting Practices

Soon finish now. The next questions are about toys (child's name) has and about things you do with him.

1. Does (child’s name) have any toys *(include all toys child is allowed to play with)*
   
   Yes   No

Show me his toys? *(Mashed up toys and toys still in the package do not count)*

<table>
<thead>
<tr>
<th>Type of toy</th>
<th>Description &amp; Number of toys</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music making toy</td>
<td></td>
</tr>
<tr>
<td>(e.g. drum, shaker, rattle)</td>
<td></td>
</tr>
<tr>
<td>Building toys</td>
<td></td>
</tr>
<tr>
<td>(e.g. blocks, boxes, lego, stacking)</td>
<td></td>
</tr>
<tr>
<td>Toys which require baby to use hands</td>
<td></td>
</tr>
<tr>
<td>(e.g. squeezy toy, hammering, beads to thread, posting bottles, crayons)</td>
<td></td>
</tr>
<tr>
<td>Gross motor toy</td>
<td></td>
</tr>
<tr>
<td>(e.g. ball, bicycle, swing, climbing object)</td>
<td></td>
</tr>
<tr>
<td>Push-a-long or pull-a-long toy</td>
<td></td>
</tr>
<tr>
<td>(i.e. toy with string or stick)</td>
<td></td>
</tr>
<tr>
<td>Pretend toy</td>
<td></td>
</tr>
<tr>
<td>(e.g. doll, puppet, toy animals, soldiers, dressing up clothes, toolset)</td>
<td></td>
</tr>
<tr>
<td>Cuddly toy</td>
<td></td>
</tr>
<tr>
<td>Toys with small wheels</td>
<td></td>
</tr>
<tr>
<td>(e.g. cars, trucks, trains)</td>
<td></td>
</tr>
<tr>
<td>Picture books</td>
<td></td>
</tr>
<tr>
<td>Picture puzzles and sorting and matching games</td>
<td></td>
</tr>
<tr>
<td>Home made toys</td>
<td></td>
</tr>
<tr>
<td>Other (specify)</td>
<td></td>
</tr>
</tbody>
</table>
2. Does he have a special place to keep play things or do you keep them in different places? (not clothes) Special place No special place

*Can count a place shared with other children. Place should be accessible for child.*

3. Do you give (child’s name) anything else to play with, anything from the house or yard?
   Yes No If yes,
   What sort of thing? ____________________________________________________

Some parents are very busy and it is difficult for them to find time to do things with their child. I’m now going to ask you about different things you might do with your child and how often you do them.

*For each question offer option ‘less than once a week’ first, e.g. less than once a week or about once a week or more than that. If response is more than that - ask how many times.*

4. Do you have time to play with toys with (child’s name)? Yes No
   If child has no toys, score No
   If yes, how often do you find time to:
   More than Daily 4/6 times a week 2/3 times a week once a week less often

5. Do you ever sing with him? Yes No
   If yes, what songs do you sing? _______________________________________

   How often do you find time to:
   More than Daily 4/6 times a week 2/3 times a week once a week less often

6. Do you play any other games with (child’s name)? Yes No
   If yes, what games do you play? _______________________________________

   How often do you find time to:
   More than Daily 4/6 times a week 2/3 times a week once a week less often

14
7. Do you ever read to him? Yes No

If yes, how often do you find time to:

- More than Daily
- 4/6 times a week
- 2/3 times a week
- once a week
- less often

8. Do you ever tell (child’s name) stories? Yes No

If yes, what about: __________________________________________________

How often do you find time to:

- More than Daily
- 4/6 times a week
- 2/3 times a week
- once a week
- less often

9. Do you ever give (child’s name) a pencil and paper to scribble? Yes No

If yes, how often do you do this

- More than Daily
- 4/6 times a week
- 2/3 times a week
- once a week
- less often

10. When you are working in the house, like cleaning or washing, do you chat him or do you leave him to play?

- Mother chats with child
- Mother doesn’t chat with child

If mother chats with child, how often

- More than Daily
- 4/6 times a week
- 2/3 times a week
- once a week
- less often

11. Do you let (child’s name) know that you love him? Yes No

If yes, how do you do that? ____________________________________________

How often do you find the time to let your child know you love him?

- More than Daily
- 4/6 times a week
- 2/3 times a week
- once a week
- less often

12. Do you tell (child’s name) the names of things in the house and in the yard? Yes No

If yes, how often do you find the time to do this?

- More than Daily
- 4/6 times a week
- 2/3 times a week
- once a week
- less often
13. Do you ever praise him (for example, say nice baby, clap him)?

Yes  No

How often did you praise your child in the last week?

| More than once a day | Daily | 4/6 times a week | 2/3 times a week | once a week | less often |

14. Is there anything special you do when you’re dressing (child’s name), any little game or activity you do? Yes  No  If yes, what?

If mother says a playful activity, record & probe 'Anything else?'

14b. How often do you do this

| Daily | 4/6 times a week | 2/3 times a week | once a week | less often |

15. And when you’re bathing him, are there any special games or activities you do? Yes  No  If yes, what?

If mother says a playful activity, record & probe 'Anything else?'

15b. How often do you do this

| Daily | 4/6 times a week | 2/3 times a week | once a week | less often |

16. At mealtimes, if your child doesn’t want to eat, what do you do?


16
I will now ask you some questions about your home.

**Crowding**

- No. of children under 15 yrs in household
- No. of children under 5 yrs.
- No. of people over 14 yrs (share food, sleep in home)
- No. of rooms in household

(Do not count bathroom or kitchen unless can sit in kitchen and eat)

**Housing**

<table>
<thead>
<tr>
<th>Toilet</th>
<th>Own inside flush</th>
<th>Own pit</th>
<th>Own outside flush</th>
<th>Shared outside flush</th>
<th>Shared inside flush</th>
<th>Shared pit</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own inside flush</td>
<td>6</td>
<td></td>
<td>2</td>
<td></td>
<td>5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Shared inside flush</td>
<td></td>
<td></td>
<td>4</td>
<td></td>
<td>3</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Own outside flush</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Shared outside flush</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water supply</th>
<th>Own inside pipe</th>
<th>Shared in yard</th>
<th>Own in yard</th>
<th>Shared in yard</th>
<th>Outside yard&lt; 100 yds</th>
<th>Outside yard &gt; 100 yds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own inside pipe</td>
<td>6</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Shared inside pipe</td>
<td>5</td>
<td></td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Own in yard</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
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</table>

**Possessions**

<table>
<thead>
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Observations

1. Mother appears pleased when visitor praises child
   *Interviewer to praise child effusively at the beginning of the visit.*
   Yes   No

2. Mother encourages child to say ‘Hello’ to interviewer.
   Yes   No

3. Mother begins conversation with visitor, asks several questions and/or makes several spontaneous comments.
   *We are looking for mothers who are forthcoming in their responses.*
   Yes   No

4. Mother answers questions well
   *Mother understands the questions easily and makes clear relevant responses without too much help.*
   Yes   No

5. Mother’s speech is distinct, clear and audible
   Yes   No

6. Mother spontaneously talks to or vocalises to child more than once during visit
   *Mother initiates talk with child.*
   Commands and scolding not counted.
   Yes   No

7. Mother responds verbally to child’s talking or babbling more than once during the visit
   *Response to fussing/crying by the child is not counted.*
   *If child doesn’t vocalise score No.*
   Mothers comments should be positive not restrictive or scolding.
   Yes   No

8. Mother tells child the name of something or event or person at least once during visit in a teaching style.
   Yes   No

9. When speaking of or to the child, mother’s voice conveys affection and warmth.
   Yes   No
10. Mother spontaneously praises child’s qualities or behaviour at least once during visit

11. Mother kisses and cuddles child or strokes more than once during visit.

   Note: One long cuddle would count as a yes.

12. Mother provides toys or other interesting activity or in other way structure the situation for child during visit when her attention will be elsewhere?

   To score yes, mother must make an active, guiding gesture or suggestion to structure the child’s play.

13. Mother keeps tabs on child’s whereabouts by brief physical checks while he is playing in another room or looks at him often if nearby

   This is expected to occur throughout the visit.

14. Mother expresses over-annoyance with or hostility toward child or complains about child once during visit.

   If mother says child is bad or rude, listen for the tone of the comment – we are looking for mothers who use a hostile or non-friendly tone.

15. Mother interferes with child’s actions or restricts child’s movement once during the visit

   Refers to unreasonable restrictions, not to ensuring child’s safety.
   Score Yes if mother restricts actions of any of her children under 5 years.
16. Mother threatens or gives intense commands or shouts at child once during visit?  
*Score Yes if mother threatens or shouts at any of her children under 5 yr*

17. Mother scolds or derogates child at least once during visit?  
*Score yes if mother scolds or derogates any of her children under 5 years*

18. Mother slaps or spanks child during visit?  
*Score yes if mother slaps or spanks any or her children under 5 years*

19. The child is reasonably clean and tidy  

20. The building or yard is potentially dangerous to child?  

21. The yard is reasonably clean and tidy?
Parenting Questionnaire

Now I want to ask you some questions about being a parent and taking care of young children.

11. Tell me some of the things you think a good parent does with her young child, a child aged 3 or younger

Do not probe

I am going to ask you some questions. Some of the questions you might agree with and others you might disagree with. I want you to think carefully and tell me what you think.

2. Will too much love and attention spoil a child?
   agree completely    agree a little bit    disagree a little bit    disagree completely

3. Do you need to hit children when they are rude or they will grow up bad?
   agree completely    agree a little bit    disagree a little bit    disagree completely

4. Is it important that a busy mother spend plenty time chatting with little babies?
   agree completely    agree a little bit    disagree a little bit    disagree completely

5. Is it important that parents start teaching children to write letters and know their abc before they are 3 years old?
   agree completely    agree a little bit    disagree a little bit    disagree completely
6. Once a child can feed himself, can he be left alone to eat?
   agree completely    agree a little bit    disagree a little bit    disagree completely

7. If you praise a child too much will it make him swell-headed (boosy, show off)?
   agree completely    agree a little bit    disagree a little bit    disagree completely

8. When teaching a young child (a child less than 3) should parents make the child sit still and listen carefully?
   agree completely    agree a little bit    disagree a little bit    disagree completely

9. Is it important that a busy mother spend plenty time playing with young children?
   agree completely    agree a little bit    disagree a little bit    disagree completely

10. Is it important that parents start teaching children to do little sums before they are 3 years old (for example, 1 + 1 make 2)?
    agree completely    agree a little bit    disagree a little bit    disagree completely

11. When teaching a young child, which is the most important:
    To praise him when he is right  or
    To point out when he is wrong

13. At mealtimes, if a child doesn’t eat much, what should a parent do?  Probe once

14. Can you tell me some ways a parent can help a young child learn to talk and understand what you say  Probe once
14. What sort of thing would you teach a child under 3 years with: **Probe each item once unless respondent says no or nothing**

- a book: __________________________________________________________
- a doll: __________________________________________________________
- pencil and paper: _________________________________________________

16. Is there anything you would teach a child under 3 years when: **Probe each item once unless respondent says no or nothing**

- Dressing him: ____________________________________________________
- Carry him out: __________________________________________________
- Bathing him: ____________________________________________________

17. When a parent is teaching a young child to do something and the child is more interested in something else, what should the parent do?

   *If respondent suggests a positive action to bring child back to task, record and probe: ‘What should you do if he is still not interested in what you’re teaching?’*
Feelings Questionnaire

Sometimes we feel sad and unhappy and other times we feel good. I now want to ask you some questions about how you’ve been feeling this past week.

2. Did anything unusual happen that bothered you during the last week? Yes No

If yes, what ____________________________________________

Explain about the past week e.g. today is Monday so I want you to tell me how you have been feeling in the past week, from last Monday until this morning.

During the past week (e.g. from last Monday until today):

3. How many nights did you not sleep well and toss and turn? ___________ nights

4. How many days did you feel so down that nothing could cheer you up? ___________ days

Sometimes we feel that we’re no good and other times we feel that we’re just as good as everyone else.

5. How many days, in the last, week did you feel that you were just as good as other people? ___________ days

17. How many days did you feel depressed? ___________ days

18. How many days did you get tired for no reason? ___________ days

19. How many days did you think your life had been a failure? ___________ days
20. How many days did you feel that no-one cares about you? 
   __________ days

21. How many days did you feel happy? 
   __________ days

22. How many days did you enjoy yourself? 
   __________ days

23. How many days did you feel like crying? 
   __________ days

24. How many days did you feel that people don’t like you? 
   __________ days

25. How many days could you not get going and didn’t feel like moving? 
   __________ days

26. How many days did you think that the future looks bad? 
   __________ days

27. How many days did you feel that life is just a whole heap of disappointments? 
   __________ days

28. How many days did you feel that life is just one problem after another problem? 
   __________ days
Parenting Practices

Soon finish now. The next questions are about toys (child's name) has and about things you do with him.

2. Does (child’s name) have any toys (include all toys child is allowed to play with)?
   Yes       No

Some parents are very busy and it is difficult for them to find time to do things with their child. I'm now going to ask you about different things you might do with your child and how often you do them.

For each question offer option ‘less than once a week’ first, e.g. less than once a week or about once a week or more than that. If response is more than that - ask how many times.

16. Do you have time to play with toys with (child’s name)? Yes       No
   If child has no toys, score No
   If yes, how often do you find time to:
   More than Daily 4/6 times a week 2/3 times a week once a week less often

17. Do you ever sing with him? Yes       No
   If yes, what songs do you sing?
   ____________________________________________
   How often do you find time to:
   More than Daily 4/6 times a week 2/3 times a week once a week less often

18. Do you play any games with (child’s name)? Yes       No
   If yes, what games do you play?
   ____________________________________________
   How often do you find time to:
   More than Daily 4/6 times a week 2/3 times a week once a week less often

19. Do you ever read to him? Yes       No
   If yes, how often do you find time to:
   More than Daily 4/6 times a week 2/3 times a week once a week less often

26
20. Do you ever tell (child’s name) stories?  
Yes  No  
If yes, what about: __________________________________________________  

How often do you find time to:  
More than Daily  4/6 times a week  2/3 times a week  once a week  less often  

21. Do you ever give (child’s name) a pencil and paper to scribble?  
Yes  No  
If yes, how often do you do this  
More than Daily  4/6 times a week  2/3 times a week  once a week  less often  

22. When you are working in the house, like cleaning or washing, do you chat with him or do you leave him to play?  
Mother chats with child  Mother doesn’t chat with child  
If mother chats with child, how often  
More than Daily  4/6 times a week  2/3 times a week  once a week  less often  

23. Do you let (child’s name) know that you love him?  
Yes  No  
How often do you find the time to let your child know you love him?  
More than Daily  4/6 times a week  2/3 times a week  once a week  less often  

24. Do you tell (child’s name) the names of things in the house and in the yard?  
Yes  No  
If yes, how often do you find the time to do this?  
More than Daily  4/6 times a week  2/3 times a week  once a week  less often
25. Do you ever praise him (for example, say nice baby, clap him)?

<table>
<thead>
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<th>Yes</th>
<th>No</th>
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How many times did you praise your child last week?

- More than once a day
- Daily
- 4/6 times a week
- 2/3 times a week
- Once a week
- Less often

26. Is there anything special you do when you're dressing (child's name), any little game or activity you do? Yes No If yes, what?

12b. How often do you do this

| Daily | 4/6 times a week | 2/3 times a week | Once a week | Less often |

27. And when you're bathing him, are there any special games or activities you do? Yes No If yes, what?

13b. How often do you do this

| Daily | 4/6 times a week | 2/3 times a week | Once a week | Less often |

14. At mealtimes, if your child doesn’t want to eat, what do you do?

15. How many times did you slap your child last week?
Responses which were coded as positive for open questions on knowledge questionnaire

12. At mealtimes, if a child doesn’t eat much, what should a parent do?

Take the child to the doctor and / or give vitamins
Feed the child often
Feed the child yourself, active feeding
Give the child something else to eat
Coax them in some way to eat
Eat with them

13. Can you tell me some ways a parent can help a young child learn to talk and understand what you say?

Talk with them
Label things
Repeat things a lot
Imitate what they say
Ask them questions
Use gestures
Respond to them / listen to them

14. What sort of thing would you teach a child under 3 years with

* A book
Name the pictures
Take care of the book
Talk about the book
A doll
To role play with the doll: wash the doll’s face etc.
To label the body parts of the doll or label clothes
To take care of the doll
Talk about the doll e.g. say the doll is a girl or a boy

Crayon and paper
Draw pictures
Scribble
Draw circles and lines

15. Is there anything you would teach a child under 3 years when

Dressing him
To dress themselves
To label the clothing
Chat about getting dressed e.g. that dress is pretty

Out walking with him
Label things around
Safety e.g. walk on the pavement, hold mother’s hand
Behaviour e.g. don’t swear, don’t cry because you want something, say please and thank you
Chatting e.g. talking about where you’re going or singing songs
Greeting e.g. saying hello to people

Bathing him
To bathe himself
To name body parts or label items e.g. soap, towel
Chat about bathing e.g. getting clean or singing songs
Play in the water e.g. splash the water, put toys in the water
Appendix 3

Messages for parents used in the intervention curriculum

Weekly record form of home visits which were completed by community health aides

Checklist for evaluation of home visits
Weekly Messages

MESSAGE 1. LOVE

Ask mother how she shows love to her child. Explain that babies and young children need lots of love so that they feel happy and wanted and grow up loving and caring.

_Throughout the visit praise the mother when she kisses, hugs and smiles at her child. Encourage mother to tell her child that she loves her._

MESSAGE 2. PRAISE

Ask the mother how she praises her child. When does she praise her child?
Talk to the mother about the importance of praising her child. When we praise a child it makes her feel smart and encourages her to try more and more and to learn faster.
Encourage the mother to praise the child
- When the child does something good
- When the child tries to do something even if he doesn’t do it right
- For just being herself, for example, is pretty, plays nicely and so on.

Ask mother what she likes about her child. Tell her it is good to tell her child that she likes this.

_Throughout the visit praise the mother when she praises her child. Tell her that she is helping her child to grow up to be smart._

MESSAGE 3. FOLLOWING WHAT CHILD WANTS TO DO

Ask the mother what sort of things her child likes to do. How does she know her child likes that? Talk to the mother about the importance of sharing in things her child likes to do. Children learn most when they are interested in what they are doing.

Encourage the mother to watch her child and see what she is doing and what she is looking at. Talk to the child about that and teach her from the things that she likes and is interested in.

_Throughout the visit praise the mother_
- _When she allows the child to do an alternate activity if child wants to._
- _When she talks to the child about what the child is doing or looking at._
Weekly Messages

MESSAGE 4. DISCIPLINE

Discuss with the mother that children learn by watching and copying others. If we hit a child when we are angry we teach the child that it is right to hit people when we are angry.

If we want children to treat other people well, we must treat them well.

Discuss ways to discipline the child without hitting them. For example:

- **Praise** the child for **good** behaviour and when possible **ignore bad** behaviour. In this way the child gets attention and love when they are good and this makes them want to be good.
- Say to the child “I know you are always a good / kind / smart girl.” This gives the child a good feeling and makes them want to be good also.

MESSAGE 5. HELPING A CHILD LEARN

When you are showing the mother and child this week’s activity demonstrate to the mother how she can help her child learn a new task. **This must be demonstrated not just told to the mother.**

To help a child learn follow these steps:

- Do what the child wants to do first. When child is ready to learn new task go on to step 2.
- Show the child the new task by doing it yourself.
- Now do the task with the child, holding her hand to help her.
- Let the child try on her own.
- Praise her if she does it right and help her if she gets it wrong.

Remember: **Never make the child feel bad if he can’t do the task – make it easier so he can do it, help him and praise him for trying.**

MESSAGE 6. ENCOURAGING A CHILD TO EAT

Ask mother how she encourages her child to eat. Praise her for good ideas and give her some more ideas to try, for example:

- Sit with child while she eats, talk to her and praise her for eating
- Help your child to eat
- Eat with your child and tell her how nice the food tastes
- Give your child food she likes
- Feed child often, not only at mealtimes
- Be calm if child won’t eat and don’t worry if the child is messy
- Add oil or butter to foods to give child more energy and help them to grow
Weekly Messages

MESSAGE 7 . RESPONDING TO YOUR CHILD / SAY WHAT YOUR CHILD WANTS TO SAY

Ask the mother how her child communicates with her. For example, how does she know when the child wants something, when the child is hungry?

Young children communicate by pointing, making noises, reaching out, crying and smiling. As they get older they start to say little words and then little sentences.

Explain to the mother that when the child is telling her something that it is good if she says what the child is trying to say.

*For example, if the child points to a banana, mother can say, “You want a banana baby”. When we respond to the child she will learn to talk faster.*

*Throughout the visit, praise the mother when she responds to her child.*
*Throughout the visit watch what the child is trying to say and talk to her about it.*

MESSAGE 8. DISCIPLINE

Remind mother that children learn by watching and copying others. If we hit a child when we are angry we teach the child that it is right to hit people when we are angry. If we want children to treat other people well, we must treat them well.

Discuss ways to discipline the child without hitting them. For example:

- Tell the child why she mustn’t do things, for example “the knife is sharp baby – hurt you”.
- Don’t just say “Rude boy” as the child doesn’t know why it is wrong
- Distract them away from the thing they are not allowed to do – for example, give them something to play with
Weekly Messages

MESSAGE 9. SHOW, NAME & TALK

Encourage mother to talk to her child, telling her things and explaining about things. In this way the child learns about the world around her.

Use Show, Name and Talk

- **Show** your child something  
  e.g. ‘Look’ (point to bath)
- **Name** it  
  Baby’s bath – it’s bathtime
- **Talk** about it  
  Mummy bathe baby, make baby clean

Demonstrate this to the mother.
Encourage the mother to do this too.

*Throughout the visit, demonstrate to the mother the use of Show, Name & Talk.*
*Throughout the visit, praise the mother when she uses Show, Name & Talk with her baby.*

MESSAGE 10. TEACH CHILD DURING DAILY ACTIVITIES

Choose **one** or **two** everyday activities (e.g. bathing child, dressing child, washing clothes, going for a walk, cleaning the house). Ask the mother what she talks about with her child during these activities. Does she play any little games? Does she sing any songs? Does she encourage her child to help her?

Praise the mother if she does this.

Discuss with the mother how children can learn lots of things through these everyday activities.

- When we tell them what we are doing they learn to talk and to understand.
- When we let them help they feel good about themselves.
- Because these things happen every day children get lots of chance to learn.

Help the mother to think of other things she can teach her child or do with her child in these everyday activities.

Encourage her to do this in the next week.
Weekly Messages

MESSAGE 11. LEARNING SHOULD BE FUN

Remind mother that children learn best when learning is fun.

Encourage the mother to make learning fun for her child.
- Don't force the child to do an activity or task
- Allow the child to do something different if she wants to
- Enjoy doing the activities with your child

Throughout the visit make the activities and tasks fun for the child. Let the mother see that you enjoy playing with the child.

Throughout the visit, praise the mother
   When she laughs and smiles and enjoys the activities
   When she allows the child to do an alternate activity if child wants to.

MESSAGE 12. DISCIPLINE

Remind mother that children learn by watching and copying others. If we hit a child when we are angry we teach the child that it is right to hit people when we are angry. If we want children to treat other people well, we must treat them well.

Discuss ways to discipline the child without hitting them. For example, for children over 2 years of age
- The child can miss a treat when they are rude and get a treat when they are good.
- Mother can give the child some choices when appropriate, for example, choose what to wear, what to eat, what game to play etc.
Weekly Messages

Message 13. HELPING YOUR CHILD LEARN II

Remind mother that children learn best when they feel smart and they get lots of praise.

Encourage the mother to make sure that her child feels smart.
  • Don’t let the child fail – make the task easier and help the child so she can do it
  • Praise the child by clapping her, kissing her, hug her up and say ‘nice baby’ when she does the task.

*Throughout the visit demonstrate to the mother how she can make her child feel smart.*

*Praise the mother when*
  • She praises her child
  • She makes the task easier or helps her child if the child has difficulty
### Visitor Curriculum Week

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<th>Curriculum Week</th>
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#### Who worked with

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<th>Other adult</th>
<th>Child</th>
<th>Toys left</th>
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#### Amount played with since last visit

| Little or no play | Played a few days | Played nearly every day |

### PROGRESS ON LAST VISITS ACTIVITIES

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<th>What child can do (alone, with help, not at all)</th>
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### THIS VISIT

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<th>Things to be taught</th>
<th>What child can do (alone, with help, not at all)</th>
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**Evaluation of CHA's Home Visits**

Early Intervention Study ERU / MOH

Name of CHA: ________________

Clinic: ________________

Date: ________________

### Visit 1

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<th>1. Interpersonal relationship between CHA and caretaker (warmth, understanding, cooperation) and type of atmosphere</th>
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<th>Poor</th>
<th>Adequate</th>
<th>Good</th>
<th>V. good</th>
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<td>2. CHA’s check on level of understanding and review of previous tasks</td>
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<td>Poor</td>
<td>Adequate</td>
<td>Good</td>
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<tr>
<td>3. CHA’s demonstration &amp; explanation of new tasks to child and caretaker</td>
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<tr>
<td>4. Feedback from caretaker on week’s activities</td>
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<td>Poor</td>
<td>Adequate</td>
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<td>5. Level of participation of caretaker</td>
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<td>Adequate</td>
<td>Good</td>
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### Visit 2

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### Visit 3

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</table>
Appendix 4

Domains tested in a selection of child development tests
### Child Development Tests

<table>
<thead>
<tr>
<th>Test</th>
<th>Component Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batelle Developmental Inventory</td>
<td>Personal-social domain</td>
</tr>
<tr>
<td></td>
<td>Adaptive domain (behaviour)</td>
</tr>
<tr>
<td></td>
<td>Motor domain</td>
</tr>
<tr>
<td></td>
<td>Communication domain (language)</td>
</tr>
<tr>
<td></td>
<td>Cognitive domain</td>
</tr>
<tr>
<td>Bayley Scales of Mental Development</td>
<td>Mental development (cognition)</td>
</tr>
<tr>
<td></td>
<td>Psychomotor development</td>
</tr>
<tr>
<td>Denver Developmental Screening Test - Revised</td>
<td>Personal social abilities</td>
</tr>
<tr>
<td></td>
<td>Fine-motor adaptive abilities</td>
</tr>
<tr>
<td></td>
<td>Language abilities</td>
</tr>
<tr>
<td></td>
<td>Gross motor abilities</td>
</tr>
<tr>
<td>Developmental Profile (DP II)</td>
<td>Physical scale (motor)</td>
</tr>
<tr>
<td></td>
<td>Self-help scale</td>
</tr>
<tr>
<td></td>
<td>Social scale (social)</td>
</tr>
<tr>
<td></td>
<td>Academic scale (cognition)</td>
</tr>
<tr>
<td></td>
<td>Communication scale (language)</td>
</tr>
<tr>
<td>Gessell Development Schedule</td>
<td>Cognitive</td>
</tr>
<tr>
<td></td>
<td>Motor</td>
</tr>
<tr>
<td></td>
<td>Personal social</td>
</tr>
<tr>
<td></td>
<td>Language</td>
</tr>
<tr>
<td>Griffiths Scales of Child Development</td>
<td>Locomotor (gross motor)</td>
</tr>
<tr>
<td></td>
<td>Hearing and speech (language)</td>
</tr>
<tr>
<td></td>
<td>Hand and eye (fine motor)</td>
</tr>
<tr>
<td></td>
<td>Performance (cognition / problem solving)</td>
</tr>
<tr>
<td></td>
<td>Personal social (social / emotional)</td>
</tr>
<tr>
<td>Kaufman Assessment Battery for Children -</td>
<td>Sequential processing (cognition)</td>
</tr>
<tr>
<td>Mental Processing Scales</td>
<td>Simultaneous processing (cognition)</td>
</tr>
<tr>
<td>McCarthy Scales of Children’s Abilities</td>
<td>Verbal Scale (language)</td>
</tr>
<tr>
<td></td>
<td>Perceptual performance scale (cognition)</td>
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<tr>
<td></td>
<td>Quantitative scale (cognition)</td>
</tr>
<tr>
<td></td>
<td>Motor scale</td>
</tr>
<tr>
<td></td>
<td>General cognitive</td>
</tr>
<tr>
<td></td>
<td>Memory (cognition)</td>
</tr>
<tr>
<td>Slosson Intelligence Test - Revised</td>
<td>Vocabulary (language)</td>
</tr>
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<td></td>
<td>General information</td>
</tr>
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<td></td>
<td>Similarity and differences (cognition)</td>
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<td></td>
<td>Comprehension (language)</td>
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<td></td>
<td>Quantitative (cognition)</td>
</tr>
<tr>
<td></td>
<td>Auditory memory (cognition)</td>
</tr>
<tr>
<td>Stanford Binet</td>
<td>Verbal reasoning (cognition)</td>
</tr>
<tr>
<td></td>
<td>Quantitative reasoning (cognition)</td>
</tr>
<tr>
<td></td>
<td>Abstract / visual reasoning (cognition)</td>
</tr>
<tr>
<td></td>
<td>Short term memory (cognition)</td>
</tr>
<tr>
<td>Weschler Scale of Children Abilities - Revised</td>
<td>Verbal subscale (language)</td>
</tr>
<tr>
<td>(WISC-R)</td>
<td>Performance subscale (cognition)</td>
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<tr>
<td>Wide Range Achievement Test (WRAT)</td>
<td>Reading (school achievement)</td>
</tr>
<tr>
<td></td>
<td>Spelling (school achievement)</td>
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<tr>
<td></td>
<td>Arithmetic (school achievement)</td>
</tr>
<tr>
<td>Woodcock-Johnson Psychoeducational battery</td>
<td>Cognitive battery</td>
</tr>
<tr>
<td></td>
<td>Achievement battery (school achievement)</td>
</tr>
</tbody>
</table>
Appendix 5

Vitamin / iron formula

Analysis of the data of children who participated in the zinc trial only
Vitamin / Iron Formula

The vitamin / iron drops provided for all the children who participated in the zinc trial contained the following per 0.5 ml:

- Vitamin A (Palmitate) 1500 IU
- Vitamin D (Calciferol) 400 IU
- Vitamin B1 (Thiamine HCl) 0.5 mg
- Vitamin B2 0.8 mg
- Nicotinamide 7.0 mg
- Vitamin B6 (pyroxidine HCl) 1.0 mg
- Vitamin C (absorbic acid) 30.0 mg
- Iron (as polysaccarhide) 8.0 mg
- Folic acid 1 mg
- Vitamin B12 2 mcg
Analysis of Data of Children in the Zinc Trial Only

To investigate differences between the groups at baseline, the children were categorized as belonging to one of 4 groups – stimulation and zinc (Both group), stimulation only (stim group), zinc only (Zn group) and control (C group). Analysis of variance (ANOVA) for continuous variables and chi-squared for categorical variables were used to explore differences between the groups at baseline on family characteristics, maternal characteristics and child’s age and gender.

Family and Maternal Characteristics
There were no differences between the groups at baseline in terms of mother’s verbal intelligence, schooling, employment status, age or presence of the baby’s father. There were also no differences in crowding, possessions and sanitation. In terms of maternal characteristics, there were no differences in child-rearing knowledge and practices, parenting self-esteem, frequency of depressive symptoms, levels of economic stress, domestic violence and community violence and home observations. There were significant differences between the groups on mother’s height (p < .05) and partner stress (p < .05) (Table A1). Post-hoc analyses showed that mother’s in the C group were significantly taller than mothers in the Zn group and mothers in the Zn group reported less partner stress than mothers in the Both group.
Table A1: Variables different between the groups at baseline

<table>
<thead>
<tr>
<th></th>
<th>C (n = 42)</th>
<th>Zn (n = 22)</th>
<th>Stim (n = 38)</th>
<th>Both (n = 27)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Mother’s height (cm)*</td>
<td>161.0 (5.4)</td>
<td>156.7 (4.9)</td>
<td>159.5 (6.1)</td>
<td>157.3 (5.8)</td>
</tr>
<tr>
<td>Median (Range)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partner stress*</td>
<td>3 (1 – 7)</td>
<td>4 (1 – 7)</td>
<td>3 (1 – 7)</td>
<td>3 (1 – 7)</td>
</tr>
</tbody>
</table>

* p < .05; **p < .01, ***p < .001

Child Characteristics

Table A2 gives the means for child anthropometry (expressed in z scores of the NCHS references) at baseline and at final evaluation. Differences between the groups were explored using ANOVAs. There were no significant differences between the groups on weight for age, weight for height and height for age at baseline and at final evaluation.

Table A2: Mean scores of anthropometric measures (z scores) by nutritional group at baseline, 6 months and 1 year

<table>
<thead>
<tr>
<th></th>
<th>C (n = 24)</th>
<th>Zn (n = 22)</th>
<th>Stim (n = 21)</th>
<th>Both (n = 27)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Weight for age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>-2.10 (.46)</td>
<td>-2.20 (.45)</td>
<td>-2.22 (.48)</td>
<td>-2.15 (.64)</td>
</tr>
<tr>
<td>After</td>
<td>-1.96 (.58)</td>
<td>-2.11 (.53)</td>
<td>-1.98 (.66)</td>
<td>-2.10 (.65)</td>
</tr>
<tr>
<td>Height for age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>-1.21 (.75)</td>
<td>-1.74 (.76)</td>
<td>-1.47 (.89)</td>
<td>-1.54 (.91)</td>
</tr>
<tr>
<td>After</td>
<td>-1.10 (.67)</td>
<td>-1.47 (.62)</td>
<td>-1.16 (.84)</td>
<td>-1.32 (.85)</td>
</tr>
<tr>
<td>Weight for height</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>-1.63 (.65)</td>
<td>-1.50 (.76)</td>
<td>-1.72 (.52)</td>
<td>-1.62 (.64)</td>
</tr>
<tr>
<td>After</td>
<td>-1.51 (.60)</td>
<td>-1.48 (.63)</td>
<td>-1.47 (.54)</td>
<td>-1.54 (.67)</td>
</tr>
</tbody>
</table>

p < .05; **p < .01, ***p < .001
Table A3 gives the unadjusted means for the child development at baseline and at final evaluation. Differences between the groups on initial and final child developmental levels were explored using analysis of covariance (ANCOVA) using child age as a covariate. At baseline, there were no significant differences between the groups on global DQ, the motor subscale, the hearing and speech subscale and the performance subscale. Significant differences between the groups were found however, for the hand and eye subscale (p < .05).

Table A3: Unadjusted mean scores on the Griffiths test by nutritional group at baseline and after 1 year

<table>
<thead>
<tr>
<th></th>
<th>C</th>
<th>Zn</th>
<th>Stim</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td><strong>DQ Before</strong></td>
<td>106.7 (11.1)</td>
<td>101.3 (10.2)</td>
<td>106.6 (9.3)</td>
<td>102.4 (8.7)</td>
</tr>
<tr>
<td><strong>After</strong>*</td>
<td>91.8 (8.8)</td>
<td>89.5 (7.3)</td>
<td>99.50 (8.9)</td>
<td>98.3 (9.2)</td>
</tr>
<tr>
<td><strong>Motor subscale</strong></td>
<td>Before</td>
<td>110.3 (13.1)</td>
<td>106.0 (11.5)</td>
<td>108.0 (12.0)</td>
</tr>
<tr>
<td></td>
<td>After</td>
<td>100.5 (15.1)</td>
<td>101.2 (12.6)</td>
<td>103.3 (12.4)</td>
</tr>
<tr>
<td><strong>Hearing &amp; speech subscale</strong></td>
<td>Before</td>
<td>108.3 (13.6)</td>
<td>101.9 (13.6)</td>
<td>109.4 (11.6)</td>
</tr>
<tr>
<td></td>
<td>After***</td>
<td>92.4 (14.1)</td>
<td>87.3 (13.7)</td>
<td>104.7 (15.9)</td>
</tr>
<tr>
<td><strong>Hand &amp; eye subscale</strong></td>
<td>Before*</td>
<td>108.4 (10.8)</td>
<td>100.2 (11.2)</td>
<td>108.2 (9.8)</td>
</tr>
<tr>
<td></td>
<td>After*</td>
<td>90.3 (8.9)</td>
<td>89.6 (9.0)</td>
<td>96.3 (11.0)</td>
</tr>
<tr>
<td><strong>Performance subscale</strong></td>
<td>Before</td>
<td>99.7 (13.3)</td>
<td>97.1 (12.9)</td>
<td>101.1 (12.0)</td>
</tr>
<tr>
<td></td>
<td>After***</td>
<td>84.3 (11.1)</td>
<td>80.0 (10.2)</td>
<td>93.5 (13.9)</td>
</tr>
</tbody>
</table>

p < .05; **p < .01, ***p < .001
At final evaluation significant differences between the groups were found for global DQ (p < .001), the hearing and speech subscale (p < .001), hand and eye subscale (p < .05) and the performance subscale (p < .001). There was no significant difference between the groups on the locomotor subscale.

**Treatment Effect on Child Nutritional Status**

Hierarchical linear multiple regressions were executed with final weight, length and BMI as the dependent measures. Raw scores were used in the analysis and the independent variables were initial anthropometry, child age and sex and zinc and stimulation treatment status both coded as a dichotomous variable (1 = treatment, 0 = control). The variables different between the groups at baseline (mother’s height and partner stress) and tester were offered at a significance level of p < .05. An interaction term of zinc status x stimulation status was also offered at a significance level of p < .1 in each analysis. The interaction term was centred to avoid colinearity with the treatment variables.

There was no significant effect of zinc supplementation nor stimulation on the nutritional status of the children and the zinc x stimulation interaction term was not significant in any of the regressions (Table A4). In addition, the between clinic variance was not significant in any of the regressions indicating that differences between the clinics in terms of the children’s developmental level was negligible.
Table A4: Multilevel analysis of the effects of intervention on child nutritional status

<table>
<thead>
<tr>
<th>Fixed parameters</th>
<th>Weight Estimate (SE)</th>
<th>Length Estimate (SE)</th>
<th>Body Mass Index (BMI) Estimate (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial score</td>
<td>1.22 ***</td>
<td>0.94 ***</td>
<td>0.59 ***</td>
</tr>
<tr>
<td></td>
<td>(0.12)</td>
<td>(0.07)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>Age</td>
<td>-0.05 **</td>
<td>-0.22***</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.07)</td>
<td>(0.02)</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.09</td>
<td>0.11</td>
<td>-0.27</td>
</tr>
<tr>
<td></td>
<td>(0.13)</td>
<td>(0.33)</td>
<td>(0.15)</td>
</tr>
<tr>
<td>Zinc</td>
<td>-0.17</td>
<td>-0.37</td>
<td>-0.06</td>
</tr>
<tr>
<td></td>
<td>(0.12)</td>
<td>(0.31)</td>
<td>(0.14)</td>
</tr>
<tr>
<td>Stimulation</td>
<td>-0.12</td>
<td>-0.22</td>
<td>-0.07</td>
</tr>
<tr>
<td></td>
<td>(0.18)</td>
<td>(0.36)</td>
<td>(0.21)</td>
</tr>
</tbody>
</table>

| Random parameters         |                      |                      |                                     |
| Clinic                    | 0.05                 | 0.08                 | 0.07                                |
|                           | (0.04)               | (0.15)               | (0.06)                              |
| Subject                   | 0.34 ***             | 2.18 ***             | 0.45 ***                            |
|                           | (0.05)               | (0.34)               | (0.07)                              |

*p < .05; **p < .01; ***p < .001
Treatment Effect on Child Development
To examine the treatment effect of zinc supplementation and stimulation on child development hierarchical linear multiple regression was conducted with the final Griffiths scores as the dependent variable and initial developmental measure, child age and zinc and stimulation treatment status as the independents. The variables different between the groups at baseline (mother’s height and partner stress) and tester were offered at a significance level of $p < .05$ and a zinc x stimulation interaction term was also offered at significance level of $p < .1$. Zinc supplementation had no significant effect on change in overall DQ, nor on any of the subscales (Table A5). Stimulation had a significant effect on overall DQ (8.33 points) and on the hearing and speech subscale (11.02 points), the hand and eye subscale (6.65 points) and the performance subscale (12.54 points). There was no significant effect of stimulation on the locomotor subscale. Tester was a significant covariate for overall DQ and the hand and eye subscale. The zinc x stimulation interaction term was not significant in any of the regressions, nor were the variables different between the groups at baseline. The between clinic variance was again not significant in any of the regressions. The clinic variance was unable to be computed for the hearing and speech subscale.
Table A5: Multilevel analysis of the effects of intervention on Griffiths developmental quotients and subscale scores.

<table>
<thead>
<tr>
<th>Fixed Parameters</th>
<th>DQ</th>
<th>Locomotor</th>
<th>Hearing &amp; Speech</th>
<th>Hand &amp; Eye</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial score</td>
<td>0.72 ***</td>
<td>0.73 ***</td>
<td>0.60 ***</td>
<td>0.31 *</td>
<td>0.57 ***</td>
</tr>
<tr>
<td></td>
<td>(0.11)</td>
<td>(0.12)</td>
<td>(0.15)</td>
<td>(0.11)</td>
<td>(0.14)</td>
</tr>
<tr>
<td>Child’s age</td>
<td>0.73 ***</td>
<td>1.12 ***</td>
<td>0.65</td>
<td>-0.41 *</td>
<td>0.70 *</td>
</tr>
<tr>
<td></td>
<td>(0.208)</td>
<td>(0.24)</td>
<td>(0.36)</td>
<td>(0.21)</td>
<td>(0.35)</td>
</tr>
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<td>Tester</td>
<td>-4.03 *</td>
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<td></td>
<td>-4.26 *</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.59)</td>
<td></td>
<td></td>
<td>(1.94)</td>
<td></td>
</tr>
<tr>
<td>Zinc</td>
<td>2.06</td>
<td>2.24</td>
<td>-2.22</td>
<td>2.50</td>
<td>1.02</td>
</tr>
<tr>
<td></td>
<td>(1.55)</td>
<td>(2.20)</td>
<td>(2.95)</td>
<td>(1.94)</td>
<td>(2.77)</td>
</tr>
<tr>
<td>Stimulation</td>
<td>8.33 ***</td>
<td>2.21</td>
<td>11.02 ***</td>
<td>6.65 ***</td>
<td>12.54 ***</td>
</tr>
<tr>
<td></td>
<td>(2.03)</td>
<td>(3.39)</td>
<td>(2.87)</td>
<td>(2.21)</td>
<td>(2.98)</td>
</tr>
</tbody>
</table>

Random Parameters

<table>
<thead>
<tr>
<th></th>
<th>DQ</th>
<th>Locomotor</th>
<th>Hearing &amp; Speech</th>
<th>Hand &amp; Eye</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinic</td>
<td>5.49</td>
<td>20.13</td>
<td>4.10</td>
<td>4.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(5.20)</td>
<td>(14.75)</td>
<td>(5.00)</td>
<td>(10.85)</td>
<td></td>
</tr>
<tr>
<td>Subject</td>
<td>49.92 ***</td>
<td>108.23 ***</td>
<td>190.24 ***</td>
<td>75.82 ***</td>
<td>170.37 ***</td>
</tr>
<tr>
<td></td>
<td>(7.85)</td>
<td>(17.08)</td>
<td>(23.82)</td>
<td>(11.86)</td>
<td>(26.48)</td>
</tr>
</tbody>
</table>

*p < .05; **p < .01; ***p < .001
Maternal Characteristics

Differences between the groups at baseline and final evaluation were explored using ANOVAs. There were no differences between the groups at baseline on mother's child-rearing knowledge, practices or frequency of depressive symptoms (Table A6). Significant differences between the groups were evident at final evaluation on maternal child-rearing knowledge (p < .001) and practices (p < .01) and the frequency of depressive symptoms (p < .05).

Table A6: Mother’s child rearing knowledge and practices and frequency of depressive symptoms by nutritional group at baseline and after 1 year

<table>
<thead>
<tr>
<th></th>
<th>Control (n = 42)</th>
<th>Zinc only (n = 22)</th>
<th>Stimulation only (n = 38)</th>
<th>Zinc and stimulation (n = 27)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Knowledge</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>25.5 (5.8)</td>
<td>24.2 (6.0)</td>
<td>24.8 (5.5)</td>
<td>24.7 (5.5)</td>
</tr>
<tr>
<td>After***</td>
<td>23.6 (6.3)</td>
<td>23.1 (5.9)</td>
<td>30.3 (6.3)</td>
<td>31.4 (7.0)</td>
</tr>
<tr>
<td><strong>Practices</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>28.5 (8.2)</td>
<td>21.2 (8.8)</td>
<td>27.5 (9.7)</td>
<td>25.0 (9.9)</td>
</tr>
<tr>
<td>After**</td>
<td>25.9 (11.7)</td>
<td>21.2 (10.6)</td>
<td>32.2 (8.6)</td>
<td>29.2 (10.9)</td>
</tr>
<tr>
<td><strong>Depression</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>29.0 (0 - 86)</td>
<td>25 (0 - 81)</td>
<td>23.0 (0 - 91)</td>
<td>40 (0 - 86)</td>
</tr>
<tr>
<td>After*</td>
<td>32.0 (0 - 89)</td>
<td>21 (1 - 81)</td>
<td>22.5 (0 - 67)</td>
<td>11.5 (0 - 98)</td>
</tr>
</tbody>
</table>

* p < .05; ** p < .01, *** p < .001
Treatment Effect on Maternal Outcomes

The effect of zinc supplementation and stimulation on maternal child rearing knowledge and practices and frequency of depressive symptoms was investigated using hierarchical multiple regressions. The independent variables were the baseline score and the child’s zinc and stimulation status. In addition, partner stress and mother’s height and tester were offered at a significance level of p < .05 and a zinc x stimulation interaction term was offered at a significance level of p < .1. There was a significant positive effect of stimulation on mother’s child rearing knowledge (7.67 points) and practices (5.77 points) and a significant negative effect of stimulation on the frequency of maternal depressive symptoms (-1.25 points) (Table A7). There was, as expected, no significant effect of zinc supplementation on any of the maternal outcomes. The between clinic variance could not be computed for the regression on depression and knowledge and the clinic variance for the practices scale was not significant.
Table A7: Multilevel analysis of the effects of intervention on mother’s child rearing knowledge and practices and frequency of depressive symptoms.

<table>
<thead>
<tr>
<th></th>
<th>Depression</th>
<th>Knowledge</th>
<th>Child Rearing Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
<td>Estimate (SE)</td>
</tr>
<tr>
<td><strong>Fixed parameters</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial score</td>
<td>0.51 ***</td>
<td>0.64 ***</td>
<td>0.64 ***</td>
</tr>
<tr>
<td></td>
<td>(0.09)</td>
<td>(0.11)</td>
<td>(0.09)</td>
</tr>
<tr>
<td>Zinc</td>
<td>-0.43</td>
<td>0.80</td>
<td>0.80</td>
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<tr>
<td></td>
<td>(0.46)</td>
<td>(1.11)</td>
<td>(1.66)</td>
</tr>
<tr>
<td>Stimulation</td>
<td>-1.12 *</td>
<td>7.67 ***</td>
<td>5.77 **</td>
</tr>
<tr>
<td></td>
<td>(0.46)</td>
<td>(1.14)</td>
<td>(2.49)</td>
</tr>
<tr>
<td><strong>Random parameters</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinic</td>
<td>0.18</td>
<td>10.71</td>
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</tr>
<tr>
<td></td>
<td>(1.55)</td>
<td>(7.87)</td>
<td></td>
</tr>
<tr>
<td>Subject</td>
<td>4.86 ***</td>
<td>27.87 ***</td>
<td>57.51 ***</td>
</tr>
<tr>
<td></td>
<td>(0.72)</td>
<td>(4.37)</td>
<td>(9.19)</td>
</tr>
</tbody>
</table>

*p < .05; **p < .01; ***p < .001