

**The effect of early stimulation on maternal depression:
A cluster randomised controlled trial**

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Abstract

Objective: To determine the effect of early childhood stimulation with undernourished children and their mothers on maternal depression.

Design: A cluster randomised controlled trial.

Setting: Children and their mothers were recruited from 18 government health centres in the parishes of Kingston, St. Andrew and St. Catherine, Jamaica.

Subjects: Mothers of 139 undernourished children (weight for age \leq -1.5 z-scores) aged 9 to 30 months.

Intervention: Weekly home visits by community health aides for one year. Mothers were shown play activities to do with their child using home made materials and parenting issues were discussed.

Main outcome measure: Frequency of maternal depressive symptoms assessed by questionnaire. Child development was also measured.

Results: Mothers in the intervention group reported a significant reduction in the frequency of depressive symptoms ($b = -0.98$; 95% confidence interval: -1.53, -0.41). The change was equivalent to 0.43 SD. The number of home visits achieved ranged from 5 to 48. Mothers receiving ≥ 40 visits and mothers receiving between 25-39 visits benefited significantly from the intervention ($b = -1.84$, 95% CI:-2.97, -0.72 and $b = -1.06$, 95% CI:-2.02, -0.11 respectively) while mothers receiving < 25 visits did not benefit. At follow up, maternal depression was significantly negatively correlated with children's developmental quotient for boys only ($r = -.35$, $p < .05$).

Conclusions: A home-visiting intervention with mothers of undernourished children, with a primary aim of improving child development, had significant benefits for maternal depression. Higher levels of maternal depression were associated with poorer developmental levels for boys only.

Introduction

Maternal depression is a common mental health problem especially in economically disadvantaged women with young children.[1] Associations have recently been reported between maternal depression during the postnatal period and subsequent undernutrition in early childhood[2][3] and between concurrent maternal depression and childhood undernutrition.[3]. Maternal depression is a risk factor for poor child development[1][2] [4] and social and emotional problems[5] and could account for some of the deficit in development found in undernourished children. The effects of maternal depression on child development have been reported to vary by gender with boys often more vulnerable than girls.[6]

The effects of home based psychosocial stimulation interventions on maternal depression have been investigated in only a few studies. The results have been inconclusive with four showing no benefits[7][8][9][10] and two showing improvements to maternal depressive symptoms on at least one occasion.[11][12] All of these studies began either prenatally or at birth and only one took place in a developing country.[10]

We previously reported that a home visiting, early stimulation programme integrated into primary health care services for undernourished children in Jamaica benefited the children's development.[13] We also found that mothers of undernourished children had higher levels of depression than mothers of better nourished children.[14] We hypothesized that the intervention, which involved weekly visits during which parenting issues were discussed would benefit maternal well-being. In this paper, we report the effect of the intervention on maternal depression.

Methods

Mothers of undernourished children enrolled at nutrition clinics in government health centres were recruited. These clinics provide health and nutrition education for mothers/caretakers and monthly monitoring of children's weights and heights. All 12 nutrition clinics in the urban areas of the parishes of Kingston and St. Andrew were included. The 12 clinics were stratified into two groups by size and randomly assigned to intervention and control groups. Preliminary investigation of records indicated that there should have been sufficient children attending the clinics in Kingston and St. Andrew to fulfill the sample size requirements. However, fewer children were available than had been anticipated especially in the centres assigned to intervention. Therefore six clinics in urban areas of the adjacent parish, St. Catherine were also enrolled. Four were randomly assigned to intervention and two to control to ensure equal numbers of children in the intervention and control groups, making a total of 11 intervention clinics and 7 control clinics. The inclusion criteria for children were 1) aged between 9 months and 30 months, 2) weight for age currently below -1.5 z scores of the National Centre for Health Statistics (NCHS) references[15] and clinic records showed that they had been below -2 z scores in the last 3 months, 3) birthweight greater than 1.8kg, 4) singleton birth and 5) absence of chronic disease and/or obvious disability.

Seven eligible mothers (5%) refused to take part (see Figure 1). Six were from intervention clinics (8.5%) and one from a control clinic (1.5%). 139 mother-child dyads, 70 from intervention clinics and 69 from control clinics were recruited into the study. Sixty-two children in each group were sufficient to detect a difference of half a standard deviation between the groups in maternal depression at 80% power and at a significance level of 5%.

The University of the West Indies Ethics Committee and the Ministry of Health, Jamaica gave ethical consent for the study. The project was explained to the mothers and written consent obtained.

Measurements

Depression

Maternal depressive symptoms were measured at baseline and after 1 year. The depression scale was based on the Centre for Epidemiological Studies Depression Scale (CES-D).[16] The CES-D scale is a 20 item questionnaire designed to assess the frequency of depressive symptoms in non-clinical populations. After piloting, the wording of the questions was adapted to be more culturally appropriate and four questions, which were misinterpreted by the mothers, were omitted. One further question was omitted as mothers perceived it as repetitive, giving a total of 15 remaining questions. Respondents were asked how many days in the last week they experienced each symptom and the number of days (0-7) was recorded. The number of days with each symptom was summed making a score of 0-105. Three of the questions were worded in a non-depressed direction to assess positive affect and to avoid response set. These questions were reverse coded and added to the negative items. The test-retest (intraclass correlation coefficient) for the depression scale over a two week period was $R = 0.71$ ($n = 20$). The internal reliability (Cronbach's alpha) of the scale was $\alpha = 0.90$ ($n = 125$). Two interviewers administered the questionnaires in the study and they were unaware of the mothers' intervention status. Interobserver agreement was $> 90\%$ for each question ($n = 22$).

Developmental assessments

The children's developmental levels were assessed at baseline and one year later using the Griffiths Mental Development Scales.[17][18] These scales have previously been modified for Jamaica where they have been shown to have good test-re-test reliability and to predict long term development.[19] Four subscales were used, locomotor, hearing and speech, hand and eye coordination and performance and these were averaged to give a global developmental quotient (DQ). The children were assessed by one of two persons who tested equal numbers from each group and were unaware of the children's group. Interobserver reliabilities were $R = 0.99$, $n = 16$ (intraclass correlation coefficients).

Child anthropometry

The children's weight and height or length was measured according to standard procedures.[20] Interobserver reliabilities were > 0.97 for all measures. Measurements

were converted into height for age (HAZ), weight for height (WHZ) and weight for age (WAZ) z scores of the NCHS references.[15]

Economic background and parental characteristics

On enrolment the mothers were interviewed at home to obtain information on parental characteristics and family structure. Standard of housing was measured by crowding (number of people per room), a sanitation score (rating of toilet and water amenities summed) and the number of household possessions from a list of 10 items. The mother's vocabulary was assessed using the Peabody Picture Vocabulary Test – Revised.[21]

The Intervention

The intervention focused on improving child development by improving mothers' knowledge and practices of child rearing and their parenting self-esteem. Community health aides visited the homes weekly for half an hour, and demonstrated age appropriate activities for the child by involving both the mother and child in play. Home made toys and books and materials in the home were used to keep the intervention low cost. The visitors were trained to ensure that both the mothers and the children experienced success and feelings of competence. Parenting issues, including the importance of praise, attention and responsiveness, appropriate discipline strategies, child nutrition and how to promote children's play and learning were also discussed. Where other caregivers (e.g. fathers, grandparents) were present, they were encouraged to take part in the intervention. Although no counseling or problem solving was explicitly included in the intervention, the visitors attempted to develop friendly relationships with the mothers and to empathise with their expressed concerns. Community health aides are paraprofessionals employed in government health centres. They receive four weeks pre-service training on health and nutrition and we provided an additional two weeks training covering child development, parenting issues and how to conduct the intervention. The supervisor observed each aide conducting visits once a month and visited the health centre every fortnight to discuss the programme and review the records of each visit.

Analysis

All variables were checked for normality. The depression score was negatively skewed so this was normalised with a square root transformation.[22] The effect of treatment was examined on an intention to treat basis using multilevel multiple regression analysis to take into account the hierarchical structure of the study. Clinic was entered as a random parameter to account for the variance among clinics. The final score of maternal depressive symptoms was the dependent variable. The independent variables were initial depression score and treatment group (stimulation =1, control=0). Interviewer was entered as an additional covariate but it was not significant.

We examined the relationship between maternal depression and child development using partial correlation coefficients between DQ and maternal depression at baseline and the end of the trial, controlling for child age, for the sexes separately. To determine whether change in depression predicted change in child development we used a multiple

regression with final DQ as the dependent variable. Initial DQ, child's age, tester, treatment group, initial and final depression were the independent variables. We also investigated whether the initial level of depression modified the treatment effect on children's DQ in a multiple regression with post intervention DQ as the dependent variable and initial DQ, child's age, tester, treatment group, initial depression and a treatment X initial depression interaction term as the independent variables.

Results

125 mothers were interviewed at final evaluation (90% follow-up) – 64 from the intervention group and 61 from the control group. Five of the families had moved out of the area (three from the control group), three mothers from the stimulation group refused the programme, five mothers were unavailable for interviewing (four from the control group) and one mother refused to answer the questionnaire (Figure 1). There were no differences between mothers lost to the study and mothers interviewed on any of the baseline characteristics.

There were no statistically significant differences between the groups in socio-economic background variables, parental characteristics and child age, developmental quotients (DQ), gender and nutritional status and maternal depression on enrolment (Table 1).

Table 1 Baseline characteristics on enrolment by treatment group.

Characteristics	Intervention Group (n = 64) Mean (SD [†])	Control Group (n = 61) Mean (SD [†])
Characteristics of child		
Child age (months)	18.4 (4.5)	18.5 (5.2)
Child gender % girls (n)	62.5 (40)	67.2 (41)
Weight for age	-2.18 (.46)	-2.15 (.45)
Weight for height	-1.70 (.54)	-1.59 (.66)
Height for age	-1.47 (.87)	-1.48 (.76)
Developmental quotient	105.4 (8.9)	104.4 (11.1)
Socioeconomic indicators		
Crowding (persons per room)	2.8 (1.3)	2.9 (1.4)
Sanitation*	7.8 (2.8)	7.9 (2.6)
Possessions**	5.1(1.9)	5.1 (1.7)
Characteristics of mother		
Mother's PPVT***	95.4 (20.8)	94.3 (18.1)
Mother's age (years)	26.0 (7.1)	25.7 (7.2)
Maternal depression (median and range)	26 (0 - 91)	27 (0 - 86)
Father lives in home % (n)	46.2 (30)	34.4 (21)
Mother works % (n)	28.1 (18)	29.5 (18)
Mother completed high school % (n)	43.8 (28)	37.7 (23)
Mother's work % (n)		
- unskilled/never worked	35.9 (23)	37.7 (23)
- semi-skilled	45.3 (29)	41.0 (25)
- skilled	18.8 (12)	21.3 (13)

[†]SDs are within clinic

*Sanitation (rating of water and toilet facilities combined) range 0 – 12

**Possessions (number of possessions) range 0-10

*** Peabody Picture Vocabulary Test (a measure of verbal IQ)

A significant decline in depressive symptoms was reported among intervention mothers but no significant change in depression was reported among control mothers. (Table 2)

Table 2 Maternal depression at baseline and follow up for intervention and control groups

	Intervention Group (n = 64) Mean (SD [†])	Control Group (n = 61) Mean (SD [†])
Maternal Depression ^{††}		
Baseline	5.0 (2.6)	4.9 (2.2)
Follow up	4.3 (2.7)	5.3 (2.1)
Change in maternal depression ^{††} Mean (95% confidence interval)	-0.64 (-0.03, -1.25)	.36 (-0.32, 1.04)

[†]SDs are within clinic

^{††}Square root transformed scores

The effect of the intervention on maternal depression was investigated in a hierarchical multiple regression controlling for initial score. The intervention had a significant benefit on maternal depression (regression coefficient (b) = -0.98; 95% confidence interval CI: -1.53, -0.41).

The number of home visits conducted with mothers and children in the intervention group ranged from 5 to 48 out of an intended 50 visits with a median of 32.5 (interquartile range: 22.5-43.0). To investigate the effect of number of visits received on change in maternal depression we compared mothers receiving < 25 visits (n = 18), 25-39 visits (n = 28) and \geq 40 visits (n = 19) with the control group. A multiple regression was conducted with final maternal depression as the dependent variable. Initial depression and dummy variables representing each of the three visit groups were entered with the control group as the reference.

Mothers receiving 40-50 visits benefited most from the intervention (regression coefficient (b) = -1.84, 95% (CI): -2.97, -0.72) followed by mothers receiving 25-39 visits (regression coefficient (b) = -1.06, 95% CI: -2.02, -0.11). Mothers receiving 0-24 visits did not differ from the control group (regression coefficient (b) = -0.09, 95% CI: -1.11, 1.13).

There were no significant correlations between maternal depression and DQ at baseline or between maternal depression at baseline and final DQ. Final DQ was significantly correlated with final maternal depression in boys ($r = -.35$, $n = 44$, $p < .05$), but not in girls ($r = .01$, $n = 81$, $p = .96$).

Change in maternal depression did not predict change in DQ. We also examined whether the mothers' initial level of depression modified the extent of benefits from treatment on children's DQ. There was no significant interaction between treatment and initial depression ($p > 0.1$).

Discussion

In this study we demonstrated that a home-visiting intervention with mothers of undernourished children, with a primary aim of improving child development, also had significant benefits for maternal depression. The effect size on maternal depression score was moderate (0.43 standard deviation) and is likely to have functional significance. This result compares favourably with other results from the literature. For example, in the Infant Health and Development Program (IHDP)[4] the benefit to mothers' distress score was 0.18 standard deviation.

Although weekly visits were planned, the community health aides could not always be released from the health centres due to the pressure of other clinic work. Significant benefits to maternal depression were found for mothers receiving 25 visits and over but mothers receiving fewer visits did not benefit. Thus, in this population, at least fortnightly visits are necessary for benefits to maternal depression to be obtained. The greatest

benefits were found for mothers receiving at least 80% of the visits. These results complement a previous study in Jamaica[23] which reported that weekly home visiting produced the largest gains to child development and at least fortnightly visiting is required to produce meaningful benefits to children's development.

The measure of maternal depression used in this study had good internal reliability and interobserver reliability and good test-retest reliability over a two week period. The instrument measures the frequency of depressive symptoms rather than clinical depression and as it has not been standardized for the Jamaican population we did not attempt to make a diagnosis. Many of these mothers may not have been clinically depressed. However, even mild forms of depression are important because they can negatively affect the quality of maternal-child interactions.[24]

Change in maternal depression did not predict change in child development suggesting that the benefits of the intervention on child development are independent of improvement in maternal depressive symptoms. These results differ from the IHDP[4] which reported that maternal emotional distress predicted child cognitive scores. A longer time period may be required before the reduction in maternal depressive symptoms has benefits on child development.

Depression was related to developmental levels only in boys at the end of the study. Other studies have shown that boys are more vulnerable to the effects of maternal depression.[6][25]

The intervention involved home visits by a community health aide and focused on child stimulation and parenting issues. The intervention also aimed to support the mother in her caregiving role and build her parenting self-esteem. Although no explicit counseling for mothers' economic and social problems was provided, the mothers often discussed these problems informally with the community health aide. Regular visits by a supportive person, ready to listen to concerns and who provides praise and encouragement is probably the mechanism leading to the reduction in depression. This hypothesis receives support from the fact that the number of home visits predicted the degree of improvement in maternal depression.

It is encouraging that home visits by paraprofessionals produced these benefits for mothers in addition to benefits to child development. The cost of using professionals in developing countries would be prohibitive. Paraprofessionals may be more successful in forming collaborative relationships with the mothers than professionals and this may be one reason for the relative success of the intervention.

Very few studies of home-based, early childhood stimulation have examined the effect on maternal psychosocial function and it is possible that these benefits have been previously overlooked. Although it has been shown that the improvement in child development is often sustained,[26] we need long term follow up to determine if the improvement in maternal depression is also sustained. In future programmes it may be useful to add a training component focusing on providing counseling and social support to mothers.

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Competing interests

None declared

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Figure legend

Figure 1 Study Design

What is already known on this topic

- Maternal depression is associated with lower levels of development, poorer social and emotional functioning and undernutrition in children.
- Few studies of home-visiting early childhood stimulation have included measurements of maternal depression.

What this study adds

- A home-visiting, early childhood stimulation programme with undernourished children had significant benefits to maternal depressive symptoms.
- At least fortnightly visits were required for benefits to maternal depression to be obtained.

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