Cite this article as: BMJ, doi:10.1136/bmj.38132.503472.&C (published 24 June 2004)

# Primary care



## Feasibility of integrating early stimulation into primary care for undernourished Jamaican children: cluster randomised controlled trial

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### Abstract

**Objectives** To assess the feasibility of integrating early psychosocial stimulation into primary care for undernourished children and to determine the effect on children's development and mothers' knowledge and practices of childrearing.
**Design** Cluster randomised controlled trial.
**Setting** 18 clinics in three Jamaican parishes.
**Participants** 139 undernourished children aged 9 to 30 months and their mothers enrolled in intervention or control clinics.
**Interventions** Weekly home visits by community health aides for one year in addition to usual duties. Parenting issues were discussed with the mothers and play activities were demonstrated with the children using homemade materials.
**Main outcome measures** Children's scores on the Griffiths mental development scales and mothers' knowledge and practices of childrearing measured by questionnaires.
**Results** Children from the intervention group showed significant improvements in development: developmental quotient, 7.8 points (95% confidence interval 4.5 to 11.1); hearing and speech, 10.7 (5.9 to 15.4 points); hand and eye coordination, 6.8 (3.4 to 10.1 points); and performance subscale, 11.0 (5.6 to 16.4 points). No improvements were shown on the locomotor subscale. The mothers from the intervention group showed improved knowledge and practices of childrearing. Change in children's body mass index and height independently affected change in development.
**Conclusion** Integrating parenting skills and early psychosocial stimulation for undernourished children into primary care was feasible and effective in improving the children's development and mothers' knowledge and practices of childrearing.


### Introduction

Around 150 million children aged under 5 years are undernourished.[1] Undernutrition in early childhood usually leads to poor cognitive development and poor school achievement.[2]

Undernutrition is usually associated with poverty and non-stimulating home environments, which affect children's development. In small controlled trials, psychosocial stimulation produced sustainable benefits in the development of undernourished children.[3 4] Yet little attempt has been made to integrate psychosocial stimulation into routine care of undernourished children.

Although many international agencies and governments promote child development programmes, little information is available on the design and effectiveness of such programmes in countries with low resources.[5–7] Health services are often the only government sector routinely making contact with children aged under 3 years. We integrated psychosocial stimulation into the primary healthcare services for undernourished Jamaican children and examined the effect on the children's development and mothers' knowledge and practices of childrearing.

### Participants and methods

We recruited undernourished children from all 12 nutrition clinics in the urban areas of the parishes of Kingston and St Andrew, Jamaica. These clinics provide education on health and nutrition for mothers and monitor their children's growth. We stratified the clinics into large and small facilities, and numbered the clinics in each group. These were then allocated to intervention or control according to a random number table. We randomised by clinic rather than by child, as it was not feasible for the children to receive different treatments within the same clinic. Fewer children were available than anticipated from the clinics' records, especially in the intervention clinics. Therefore we enrolled six clinics in the urban area of the adjacent parish of St Catherine. Four were randomly assigned to intervention and two to control to ensure similar numbers of children in each group, totalling 11 intervention clinics and seven control clinics. We obtained the mothers' written informed consent before enrolling their children. Inclusion criteria were age between 9 and 30 months, weight for age less than −1.5 z scores (reference values from the National Centre for Health Statistics) and less than −2.0 z scores in the past three months, birth weight greater than 1800 g, singleton birth, and absence of chronic disease and obvious disability. Six mothers from intervention clinics and one from a control clinic refused to take part (fig 1).

Overall, we recruited 70 mother-child dyads from intervention clinics and 69 from control clinics. We determined that 62 children in each group would be sufficient to detect a difference on the Griffiths mental development scales (the primary outcome) of 5 developmental quotient points (half a standard deviation) between the groups, with 80% power at the 5% significance level. Half a standard deviation has been associated with long term benefits on cognitive function in children.[8]

#### Outcome measures

*Assessment of development*
The children's developmental levels were assessed with the Griffiths mental development scales at baseline and one year later.[9 10] These scales were developed in the United Kingdom but have

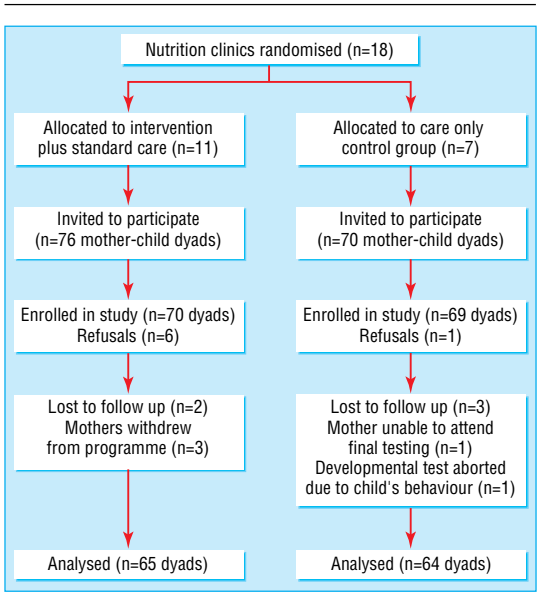


**Fig 1** Flow of clinics and mother-child dyads through trial

been used in Jamaica.[3] They have good test-retest reliability and predict long term development.[3] We used four subscales—locomotor skills, hearing and speech, hand and eye coordination, and performance. These were averaged to give a global developmental quotient. Higher scores indicate better development. We excluded two subscales: the personal-social subscale as it is culturally inappropriate, and practical reasoning because this is not possible in children aged under 2 years. The children were assessed by one of two people, who tested similar numbers from each group and were unaware of the allocation group.

*Anthropometry*

The children's weight and length or height were measured by standard procedures. Interobserver reliabilites were >0.97 for both measures.

*Mothers' knowledge and practices of childrearing*

Mothers' knowledge and practices of childrearing were assessed by questionnaires at baseline and at one year. The questionnaire on knowledge of childrearing was specifically developed for our study. It comprises 20 questions on appropriate feeding practices and activities likely to promote language and cognitive development in children. Higher scores are associated with better knowledge. The responses were summed to give a total score (maximum 70). The questionnaire on childrearing practices comprises 15 questions, which assess how often the mother involves her child in a range of activities, such as singing, playing games, using crayons, and looking at a book. The questions were based on the maternal items of the home observation for measurement of the environment scale.[11] The items were summed (maximum score 62). The test-retest reliability (intraclass correlation coefficient) for 20 mothers over two weeks for the knowledge scale was 0.71 and for the practices scale was 0.98. The test-retest reliability over one year for the whole sample was 0.58 for knowledge of childrearing and 0.61 for childrearing practices. Internal reliability using Chronbach's α was 0.77 for the practices scale and 0.54 for the knowledge scale.

On enrolment a researcher visited the homes and collected information on socioeconomic background. The mother's height was measured and her verbal IQ assessed using the revised Peabody picture vocabulary test.[12]

### Intervention

Over one year the community health aides visited the homes weekly for half an hour and demonstrated play activities involving the mother and child. Homemade toys and books and materials in the home were used to reduce the cost of the intervention. The aides followed a structured curriculum used in previous studies[13 14] but which was adapted for our study so that fewer materials were needed. Toys were left in the homes each week and exchanged at each visit. Parenting issues were discussed.

Community health aides are paraprofessionals who assist in clinics and visit homes to give advice on health and nutrition, particularly for families at risk. They receive six to eight weeks' training, primarily in maternal and child health. The community health aides who were to deliver the intervention attended two additional one week workshops covering child development and the intervention. Once a month the supervisor observed each aide conducting visits and visited the clinics fortnightly to discuss the programme and to review the records of the visits. Similar training was provided for the aides in the control clinics at the end of the study.

### Statistical analysis

All analyses were conducted on an intention to treat basis. Multilevel multiple regression analysis was used to examine the effect of intervention, taking into account the hierarchical structure of the study. Clinic was entered as a random variable to account for the variance among clinics. We entered the initial measure in each analysis to assess change while adjusting for initial status. The groups were similar at enrolment; however, to adjust for two apparent imbalances, we included the variables of father lives with child and mother completed high school. We also adjusted for tester. Treatment group (intervention, n=1; control, n=0) was entered in the final step. Age and sex were entered in the anthropometric analyses because of their well established association. In the developmental analyses, age was entered because it has been shown that scores decline across this age range in this population.

Separate regressions were computed to examine the treatment effect on developmental quotient and each subscale score, mothers' knowledge and practices of childrearing, and final weight, length, and body mass index. Most children (92%) had length and height measured on 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+1.002 height).

## Results

Overall, 129 children (93% of those enrolled) were assessed at the end of the study. Five of the families had moved (three from control clinics), three mothers from intervention clinics refused to take part, one child from a control clinic was not available for testing, and one child from a control clinic could not be tested. Four mothers of children who had a repeat test completed did not complete the repeat questionnaire (three controls and one intervention), giving a total of 125 mothers (90% of the sample).

On enrolment the groups were similar for socioeconomic background and parental characteristics, sex of child, initial age, nutritional status, Griffith's scores, anthropometry, and mothers' knowledge and practices of childrearing (tables 1 and 2).

**Table 1** Characteristics of children and family on enrolment. Values are means (standard deviations) unless indicated otherwise

| Characteristics | Intervention group (n=65) | Control group (n=64) |
|---|---|---|
| **Children** | | |
| Age (months) | 18.3 (4.8) | 18.6 (5.2) |
| No (%) girls | 40 (62) | 45 (70) |
| Weight for age (z score) | –2.2 (0.5) | –2.2 (0.5) |
| Weight for height (z score) | –1.7 (0.6) | –1.6 (0.7) |
| Height for age (z score) | –1.5 (0.9) | –1.5 (0.8) |
| **Home** | | |
| Crowding (people per room) | 2.8 (1.4) | 2.9 (1.8) |
| Sanitation* | 7.9 (3.1) | 7.7 (3.1) |
| Possessions† | 5.1 (2.0) | 5.1 (1.9) |
| **Mothers** | | |
| Height (cm) | 158.8 (6.0) | 159.2 (5.5) |
| Verbal IQ‡ | 94.3 (23.3) | 92.3 (19.6) |
| Age (years) | 26 (7.5) | 25.8 (7.4) |
| No (%) who completed high school | 28 (43) | 24 (38) |
| No (%) who work: | 19 (29) | 21 (33) |
| Unskilled or never worked | 23 (35) | 24 (38) |
| Semiskilled | 29 (45) | 26 (41) |
| Skilled | 13 (20) | 14 (22) |
| **Fathers** | | |
| No (%) living with child | 30 (46) | 22 (34) |

*Rating (range 0-12) of water and toilet facilities combined.
†Number (range 0-11) of possessions.
‡Measured with revised Peabody picture vocabulary test.

### Treatment effects

The intervention had significant benefits on the children's development: 7.8 developmental quotient points (95% confidence interval 4.5 to 11.1); hearing and speech, 10.7 (5.9 to 15.4 points), hand and eye coordination, 6.8 (3.4 to 10.1 points), and performance, 11.0 (5.6 to 16.4 points; table 3). We found no significant effect of the intervention on locomotor skills. The intervention showed a significant benefit on mothers' knowledge of childrearing (7.6, 5.7 to 9.4 points) and childrearing practices (5.0, 1.6 to 8.4 points; table 3). The intervention had no effect on gain in length or body mass index. Growth did not modify the effects of intervention, but change in length and body mass index predicted the developmental quotient (length B = 1.0, 95% confidence interval 0.1 to 1.9; body mass index B = 2.8, 0.9 to 4.7).

Out of an intended 50 visits, the median number of home visits to mothers and children from intervention clinics was 32.5 (interquartile range 22.5-43.0). The number of visits had no significant effect on child and maternal outcomes.

## Discussion

Government health aides based in primary healthcare centres in Jamaica successfully delivered an intervention to promote children's development in addition to their usual duties. The intervention had substantial benefits on development (7.8 developmental quotient points, which is an effect size of 0.8 SD). The decline in developmental levels shown by children from control clinics is common in children from poor backgrounds,[15] and intervention reduced this decline. In previous Jamaican studies, gains of this size have led to long term benefits, which should have functional significance.[3 4] The benefits were greater than the average gain found in developed countries of 0.5 standard deviations for centre based programmes and less for programmes based on home visits.[8 16] Benefits were shown in all subscales except that for locomotor skills. Growth did not influence the effect of intervention but was related to change in development.

**Table 2** Children's scores on Griffiths mental development scales and anthropometric measures, and mother's knowledge and practices of childrearing at baseline and one year's follow up. Values are means (standard deviations)

| Measure | Intervention group (n=65) | Control group (n=64) | Difference |
|---|---|---|---|
| **Children** | | | |
| Developmental quotient: | | | |
| Baseline | 105.3 (9.3) | 104.2 (11.0) | –1.14 (1.79) |
| Follow up | 99.2 (9.0) | 91.3 (8.4) | –7.97 (1.53) |
| Locomotor skills: | | | |
| Baseline | 108.7 (11.0) | 108.5 (12.6) | –0.19 (2.08) |
| Follow up | 104.2 (12.2) | 102.1 (14.2) | –2.05 (2.33) |
| Hearing and speech: | | | |
| Baseline | 106.3 (11.7) | 104.7 (13.7) | –1.55 (2.24) |
| Follow up | 100.7 (15.4) | 89.4 (13.9) | –11.28 (2.59) |
| Hand and eye coordination: | | | |
| Baseline | 106.8 (9.7) | 104.9 (11.4) | –1.89 (1.86) |
| Follow up | 97.6 (10.7) | 90.6 (8.9) | –6.98 (1.73) |
| Performance: | | | |
| Baseline | 99.6 (12.7) | 98.6 (13.1) | –0.97 (2.27) |
| Follow up | 94.5 (15.3) | 83.0 (10.9) | –11.51 (2.34) |
| Weight (kg) | | | |
| Baseline | 8.5 (1.0) | 8.6 (0.9) | 0.03 (0.16) |
| Follow up | 10.9 (1.2) | 11.0 (1.1) | 0.14 (0.19) |
| Height (cm): | | | |
| Baseline | 76.8 (5.4) | 76.8 (5.4) | –0.01 (0.95) |
| Follow up | 88.3 (4.6) | 88.2 (4.2) | –0.15 (0.78) |
| Body mass index: | | | |
| Baseline | 14.5 (0.9) | 14.6 (1.0) | 0.07 (0.17) |
| Follow up | 14.1 (0.9) | 14.4 (0.9) | 0.24 (0.16) |
| **Mothers** | | | |
| Knowledge of childrearing*: | | | |
| Baseline | 25.0 (5.5) | 24.6 (5.9) | –0.38 (0.99) |
| Follow up | 31.0 (6.5) | 23.2 (6.1) | –7.82 (1.14) |
| Childrearing practices*: | | | |
| Baseline | 27.6 (9.9) | 25.6 (8.9) | –2.03 (1.67) |
| Follow up | 31.4 (9.7) | 24.5 (11.5) | –6.92 (1.89) |

*Intervention, n=64; control, n=61.

The improvements in mothers' knowledge and practices of childrearing may be important for sustainability of benefits to

**Table 3** Multilevel analysis of effects of intervention on children's Griffiths scores and anthropometric measurements, and mothers' knowledge and practices of childrearing

| Measure | Regression coefficient, B (95% CI) |
|---|---|
| Children: | |
| Developmental quotient | 7.80*** (4.51 to 11.08) |
| Locomotor skills | 1.77 (–4.15 to 7.69) |
| Hearing and speech | 10.68*** (5.92 to 15.44) |
| Hand and eye coordination | 6.76*** (3.40 to 10.12) |
| Performance | 11.02*** (5.63 to 16.41) |
| Weight (kg) | –0.17 (–0.47 to 0.13) |
| Height (cm) | 0 (–0.68 to 0.68) |
| Body mass index | –0.24 (–0.64 to 0.16) |
| Mothers: | |
| Knowledge of childrearing | 7.57*** (5.74 to 9.40) |
| Childrearing practices | 5.00** (1.59 to 8.41) |

Developmental measures adjusted for clinic, child's age, initial score, tester effect, father living with child, and mother's education. Anthropometric measurements adjusted for clinic, child's age, child's sex, initial score, tester effect, father living with child, and mother's education. Maternal measures adjusted for clinic, initial score, tester effect, father living with child, and mother's education.
**P<0.01; ***P<0.001.

## What is already known on this topic

Children who are undernourished usually have poor cognition and poor school achievement

Controlled trials have shown that psychosocial stimulation can have sustained benefits on children's development

## What this study adds

Child development activities were successfully integrated into primary healthcare services for undernourished Jamaican children

The intervention was effective in improving the children's development and their mothers' knowledge and practices of childrearing

children and their siblings.[17] Few studies have evaluated the effects of home visits on mothers' childrearing practices, but they have generally found benefits.[18]

We encountered several problems with our intervention. We initially piloted the study using groups in the clinics, but mothers failed to attend often enough for many reasons, including expense and transport. We therefore changed to home visits as the community health aides already visited undernourished children. Weekly visits were not achieved, mainly because of the pressure of other clinic work. On average the children were visited every 10 or 11 days; this frequency was sufficient to produce benefits. The intensity of intervention is usually related to the benefits.[19 20] This was not the case in our study, however, possibly because a small number of mothers received few home visits.

National governments would need to commit some resources to enable child development activities to be integrated into primary healthcare services and for them to be sustainable. Community health aides would need an additional two weeks' training, and clinic nurses would need to be trained to supervise them. A full time coordinator would also be needed. Curriculum manuals, tools, and materials for making toys would incur costs. We determined that each aide could visit 3-5 children in addition to usual duties, which would take about half a day. The cost and workload of similar paraprofessionals varies by country and the number of children served would depend on this. As there was a limit to the number of children who could be visited, the programme would be most suitable for those at high risk.

We thank research assistants Pauline Alcott, Ava Mundell, Joan Thomas, and Michael Ennis, and the public health nurses, the community health aides, the clinic staff, and the parents and children who participated in the study.

Contributors: CP, SGM, SW, JG were responsible for the conceptualisation and design of the study. CP and HBH supervised the intervention. HBH, SGM, and CP analysed the data and HBH drafted the paper. All authors contributed to the critical review of the paper and approved the final draft for publication. CP will act as guarantor for the paper.

Funding: This study was supported by the Thrasher Research Fund, USA, with subsidiary grants from the British High Commission's Department for International Development, Jamaica, and the University of the West Indies Mona Campus research and publication fund. The Ministry of Health Jamaica supported the community health aides. This work was undertaken in collaboration with Great Ormond Street Hospital for Children NHS Trust, which receives a proportion of its funding from the NHS Executive.

Competing interests: None declared.

Ethical approval: University of the West Indies ethics committee and the Ministry of Health, Jamaica.

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*(Accepted 1 April 2004)*

doi 10.1136/bmj.38132.503472.7C

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