Effects of psychosocial stimulation and dietary supplementation in early childhood on psychosocial functioning in late adolescence: follow-up of randomised controlled trial

Susan P Walker, Susan M Chang, Christine A Powell, Emily Simonoff, Sally M Grantham-McGregor

Editorial by Dosani

Epidemiology Research Unit, Tropical Medicine Research Institute, University of the West Indies, Mona, Kingston 7, Jamaica
Susan P Walker *professor*
Susan M Chang *lecturer*
Christine A Powell *senior lecturer*
Institute of Psychiatry, London SE5 8AF
Emily Simonoff *professor*
Institute of Child Health, London WC1N 1EH
Sally M Grantham-McGregor *professor*
Correspondence to: S Walker susan.walker@uwimona.edu.jm

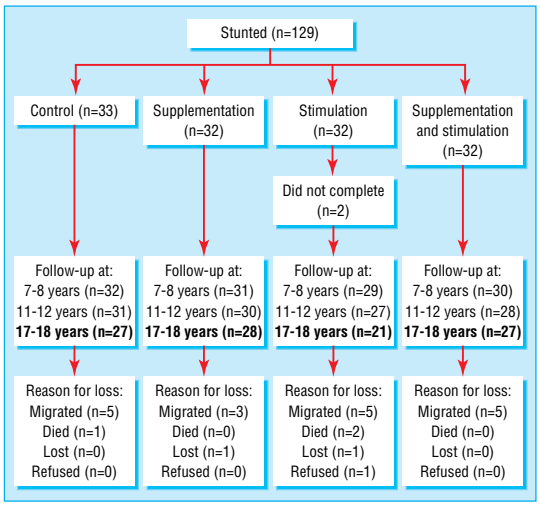
BMJ 2006;333:472–4

Abstract

Objective To determine whether dietary supplementation or psychosocial stimulation given to growth retarded (stunted) children age 9-24 months has long term benefits for their psychosocial functioning in late adolescence.
Design Sixteen year follow-up study of a randomised controlled trial.
Setting Poor neighbourhoods in Kingston, Jamaica.
Participants Of 129 stunted children identified at age 9-24 months, 103 adolescents aged 17-18 were followed up.
Intervention Supplementation with 1 kg milk based formula each week or psychosocial stimulation (weekly play sessions with mother and child), or both, for two years.
Main outcome measures Anxiety, depression, self esteem, and antisocial behaviour assessed by questionnaires administered by interviewers; attention deficit, hyperactivity, and oppositional behaviour assessed by interviews with parents.
Results Primary analysis indicated that participants who received stimulation had significantly different overall scores from those who did not ($F = 2.047$, $P = 0.049$). Supplementation had no significant effect ($F = 1.505$, $P = 0.17$). Participants who received stimulation reported less anxiety (mean difference −2.81, 95% confidence interval −5.02 to −0.61), less depression (−0.43, −0.78 to −0.07), and higher self esteem (1.55, 0.08 to 3.02) and parents reported fewer attention problems (−3.34, −6.48 to −0.19). These differences are equivalent to effect sizes of 0.40-0.49 standard deviations.
Conclusions Stimulation in early childhood has sustained benefits to stunted children's emotional outcomes and attention.

Introduction

Stunted children show behavioural changes in early childhood—they are less happy, more apathetic, and more fussy than non-stunted children.[1] Children who were admitted to hospital for severe malnutrition in early childhood show aggressive behaviour, attention deficits, and poor social relationships when they reach school age.[2–4] In high risk children in developed countries, psychosocial stimulation in early childhood reduces antisocial behaviour and delinquency in adolescence.[5 6] We conducted a two year randomised trial of dietary supplementation and psychosocial stimulation in stunted Jamaican children aged 9-24 months. When assessed at 7 and 11 years, stimulation significantly benefited cognitive function.[7] Small benefits from supplementation seen at 7 years were not detected at 11 years. Parents of stunted children reported more problems with conduct than parents of non-stunted children at 11 years.[8] We conducted a follow-up study of the participants at 17-18 years to determine any benefits from the interventions in early childhood on their current psychosocial functioning.



Flow of participants through the study

Methods

Initial study

In 1986-7 we identified children aged 9-24 months by house to house survey of poor neighbourhoods of Kingston, Jamaica. We randomly assigned 129 stunted children identified (length for age less than −2 standard deviations of the National Center for Health Statistics references[9]) to one of four groups—control, supplementation, stimulation, or both interventions. We visited all participants weekly for two years. Supplementation comprised 1 kg milk based formula each week.[10] Stimulation comprised weekly one hour visits to the home that focused on enhancing interactions between mother and child (see bmj.com). One hundred and twenty seven children completed the study.

Follow-up at 17-18 years

We assessed the psychosocial functioning of the cohort in 2002-3 when participants were aged 17-18 years. We interviewed 103 participants—80% of those who started the trial (figure).

Psychosocial functioning—We assessed self esteem, anxiety, depression, and antisocial behaviour using

ELPS *This is the abridged version of an article that was posted on bmj.com on 28 July 2006: http://bmj.com/cgi/doi/10.1136/bmj.38897.555208.2F*

Table 1 Psychosocial outcomes in trial of supplementation and stimulation in stunted children in Jamaica. Values are mean (95% confidence interval)*

Measure	Control (n=27)	Supplemented (n=28)	Stimulated (n=21)	Supplemented and stimulated (n=27)
Anxiety	15.8 (13.6 to 18.0)	16.9 (14.6 to 19.2)	13.5 (10.6 to 16.4)	13.7 (11.8 to 15.6)
Depression†	7.3 (5.8 to 9.0)	6.8 (4.8 to 9.0)	4.4 (2.6 to 6.8)	5.8 (4.8 to 6.8)
Self esteem	25.2 (23.8 to 26.6)	23.2 (21.9 to 24.5)	26.3 (24.2 to 28.3)	25.1 (23.6 to 26.6)
Antisocial behaviour†	5.8 (4.4 to 7.3)	4.8 (3.2 to 6.8)	4.4 (3.2 to 5.8)	4.4 (2.9 to 6.3)
Attention deficit	15.0 (11.3 to 18.7)	13.6 (10.4 to 16.8)	9.6 (6.3 to 13.0)	12.0 (9.3 to 14.7)
Cognitive problems or lack of attention	7.1 (5.1 to 9.1)	6.4 (4.7 to 8.2)	5.9 (3.8 to 8.0)	5.4 (4.1 to 6.8)
Hyperactivity	4.6 (3.2 to 6.0)	4.8 (3.6 to 6.1)	4.8 (3.0 to 6.5)	4.3 (3.0 to 5.6)
Oppositional behaviour	7.4 (5.6 to 9.3)	7.9 (5.8 to 9.9)	6.0 (3.9 to 8.1)	6.0 (3.9 to 8.2)

*Higher scores indicate worse psychosocial functioning except for self esteem where higher scores indicate better self esteem.
†Variables normalised using square root transformation; the values shown are squares of the transformed data.

questionnaires administered in a private interview.[11–14] To obtain information on attention deficit, cognitive problems, hyperactivity, and oppositional behaviour we questioned the mothers or primary carers.[15]

Social behaviours—We used a questionnaire to obtain information on education, sexual relationships, pregnancy, contact with the police, and exposure to violence.

Socioeconomic background—We asked participants about the frequency of hunger due to lack of food at home during the previous year. Homes were visited and information obtained on water and toilet facilities, crowding, and number of household possessions from a list of 11 items. We recorded the mother's or primary carer's education and occupation. We assessed the mother's verbal intelligence when the children were 11 years old.

Statistical analysis

Effects of the interventions were determined by intention to treat. We determined whether the interventions had significant overall effects on the outcomes; in secondary analyses, we examined the effects of interventions on individual outcomes.

Results

Loss from study—Loss to follow-up was modest and similar in all groups (figure). Enrolment measures were similar in participants and children who were lost, except that in the non-stimulated groups children lost from the study had lower weight for height ($P=0.014$) and younger mothers ($P<0.001$) than those who were assessed. Mother's age was not associated with any of the outcome variables, and weight for height was associated with antisocial behaviour only. In analyses of antisocial behaviour we therefore controlled for initial weight for height.

Background characteristics—At follow-up, we found no significant differences between the groups. When we combined the groups in which the children received psychosocial stimulation and compared them with those who did not, the stimulated group reported less hunger ($P=0.03$). We found no significant differences by intervention status in any other social background variables.

Effects of treatment—Table 1 shows the psychosocial outcomes by group. Multivariate ANOVA with all outcomes as the dependent variables and supplementation and stimulation as factors indicated a significant effect of stimulation ($F=2.047$, $P=0.049$) but not supplementation ($F=1.505$, $P=0.17$). We performed regressions for the individual outcomes to determine which outcomes differed between groups. Participants who received psychosocial stimulation in early childhood reported significantly less anxiety, fewer symptoms of depression, and better self esteem than non-stimulated stunted participants (table 2). They were also rated as having fewer attention problems by their parents. When we used a more stringent level of significance ($P<0.01$, because of the multiple comparisons) only the difference in reported anxiety was statistically significant. We found no significant interactions between stimulation and supplementation.

Social behaviour

The groups did not differ regarding contact with the police. Apart from being stopped for questioning by the police (reported by 47.6% of participants), few contacts were reported. The groups did not differ in sexual behaviour or in use of alcohol, cigarettes, and marijuana. Participants who had received stimulation were less likely to have been suspended from school (stimulation 31.3%, no stimulation 47.3%; $P=0.10$) or expelled (stimulation 2.1%, no stimulation 10.9%; $P=0.08$) than participants who did not receive stimulation.

Discussion

Psychosocial stimulation in early childhood had sustained benefits for the psychosocial functioning of stunted children. We found no sustained benefits from dietary supplementation.

In our study, supplementation had small benefits to height during the intervention, and supplementation only increased the net energy intake by 440 kJ/day.[10] A

Table 2 Multiple regression analysis of the effects of early childhood stimulation on psychosocial functioning at age 17-18 years

Measure	Mean difference (95% confidence interval)	P value
Anxiety	–2.81 (–5.02 to –0.61)	0.01
Depression*	–0.43 (–0.78 to –0.07)	0.02
Self esteem	1.55 (0.08 to 3.02)	0.04
Antisocial behaviour*†	–0.11 (–0.44 to 0.23)	0.53
Attention deficit	–3.34 (–6.48 to –0.19)	0.04
Cognitive problems or lack of attention	–1.07 (–2.79 to 0.65)	0.22
Hyperactivity	–0.20 (–1.57 to 1.17)	0.77
Oppositional behaviour	–1.64 (–3.60 to 0.32)	0.10

*Square root transformation used in analyses.
†Initial weight for height entered in regression.

What is already known on this topic

Linear growth retardation (stunting) in childhood is associated with cognitive deficits and poor educational achievement in late adolescence

Stunting is also associated with behavioural problems at 9-11 years of age

Psychosocial stimulation in early childhood has long term benefits for stunted children's cognitive outcomes

What this study adds

A programme of home based psychosocial stimulation had sustained benefits for stunted children's emotional outcomes and attention

higher level or longer duration of supplementation may have led to greater benefits.

Stunted children who participated in the stimulation programme reported fewer symptoms of depression and anxiety and better self esteem and attention than those who did not receive the intervention. The changes in scores for anxiety, depression, and self esteem were 0.4-0.49 of a standard deviation. At an individual level, these effects are not large. However, at a population level, these changes could have an important role in reducing emotional disorders. Loss to follow-up was modest, and the interviewers were blind to the participants' group.

Few long term studies have evaluated interventions in early childhood in disadvantaged but adequately nourished children.[16] The main benefit reported in psychosocial functioning is reduction in antisocial behaviour.[5 6] In our study, participants in the stimulated group were suspended or expelled from school less often, but we found no benefits to self reported antisocial behaviour.

Intervention studies in the United States have shown that children who are more disadvantaged benefit most.[5] The Jamaican children studied here were undernourished and came from very poor families, and this may have contributed to the wide ranging benefits of intervention. [17]

The intervention was aimed at improving the mother-child relationship; it emphasised listening and chatting to the children, allowing them to experience success, praising their actions, and reducing punishment. In another recent trial with a similar intervention, mothers in the intervention arm had reduced symptoms of depression.[18] Improved psychosocial functioning in the mothers may also have been beneficial to the children. The benefits of stimulation to the educational achievement of the participants may also have contributed to better emotional outcomes.

Stimulation in early childhood produced sustained improvements to the psychosocial functioning of stunted children. The next challenge is to develop interventions that can meet the needs of the enormous number of stunted children.

Thanks to Amika Wright and Sydonnie Shakespeare for conducting the interviews and the participants and their parents for their continued cooperation.

Contributors: See bmj.com.

Funding: Supported by a grant from the Wellcome Trust (066088). The funders approved the study design but had no involvement in data collection, analysis, interpretation, or writing the report.

Competing interests: None declared.

Ethical approval: Ethics committees of the University of the West Indies and the Institute of Child Health, University College, London.

1 Gardner JM, Grantham-McGregor SM, Himes J, Chang S. Behaviour and development of stunted and nonstunted Jamaican children. *J Child Psychol Psychiatry* 1999;40:819-27.
2 Galler JR, Ramsey F. A follow-up study of the influence of early malnutrition on development: behavior at home and at school. *J Am Acad Child Adolesc Psychiatry* 1989;28:254-61.
3 Richardson SA, Birch HG, Grabie E, Yoder K. The behavior of children in school who were severely malnourished in the first two years of life. *J Health Soc Behav* 1972;13:276-84.
4 Richardson SA, Birch HG, Ragbeer C. The behaviour of children at home who were severely malnourished in the first 2 years of life. *J Biosoc Sci* 1975;7:255-67.
5 Olds D, Henderson CR Jr, Cole R, Eckenrode J, Kitzman H, Luckey D, et al. Long-term effects of nurse home visitation on children's criminal and antisocial behavior: 15-year follow-up of a randomized controlled trial. *JAMA* 1998;280:1238-44.
6 Yoshikawa H. Long-term effects of early childhood programs on social outcomes and delinquency. *Future Child* 1995;5:51-75.
7 Walker SP, Grantham-McGregor SM, Powell CA, Chang SM. Effects of growth restriction in early childhood on growth, IQ, and cognition at age 11 to 12 years and the benefits of nutritional supplementation and psychosocial stimulation. *J Pediatr* 2000;137:36-41.
8 Chang SM, Walker SP, Grantham-McGregor S, Powell CA. Early childhood stunting and later behaviour and school achievement. *J Child Psychol Psychiatry* 2002;43:775-83.
9 Hamil P, Drizd T, Johnson C, Reed R, Roche A. *Growth curves for children, birth-18 years. 165 (DHEW 78-1650), vital and health statistics series 11.* Hyatsville, MD: National Center for Health Statistics, 1977.
10 Walker SP, Powell CA, Grantham-McGregor SM, Himes JH, Chang SM. Nutritional supplementation, psychosocial stimulation, and growth of stunted children: the Jamaican study. *Am J Clin Nutr* 1991;54:642-8.
11 Warr P, Jackson P. Self-esteem and unemployment among young workers. *Le Travail Humain* 1983;46:355-66.
12 Reynolds CR, Richmond BO. What I think and feel: a revised measure of children's manifest anxiety. *J Abnorm Child Psychol* 1978;6:271-80.
13 Costello EJ, Angold A. Scales to assess child and adolescent depression: checklists, screens, and nets. *J Am Acad Child Adolesc Psychiatry* 1988;27:726-37.
14 Olweus D. Persistence and prevalence in the study of antisocial behaviour: definitions and measurement. In: Klein MW, ed. *Cross-national research in self reported crime and delinquency.* Dordrecht, Netherlands: Kluver, 1989.
15 Conners CK, Sitarenios G, Parker JD, Epstein JN. The revised Conners' parent rating scale (CPRS-R): factor structure, reliability, and criterion validity. *J Abnorm Child Psychol* 1998;26:257-68.
16 Farran DC. Another decade of intervention for children who are low income or disabled: What do we do now? In: Shonkoff JP, Meisels SJ, eds. *Handbook of early childhood intervention.* New York: Cambridge University Press, 2000:501-39.
17 Walker SP, Chang SM, Powell CA, Grantham-McGregor SM. Effects of early childhood psychosocial stimulation and nutritional supplementation on cognition and education in growth-stunted Jamaican children: prospective cohort study. *Lancet* 2005;366:1804-7.
18 Baker-Henningham H, Powell C, Walker S, Grantham-McGregor S. The effect of early stimulation on maternal depression: a cluster randomised controlled trial. *Arch Dis Child* 2005;90:1230-4.

(Accepted 7 June 2006)

doi 10.1136/bmj.38897.555208.2F

The conscientious physician

Dyspepsia is, indeed, the malady above all others, in which a variety of quackeries, work their pretended cures . . . A person suffers from dyspepsia takes a certain remedy. He recovers. Therefore he is cured by it. So runs the popular conclusion. But the conscientious physician can accept no such flattering or delusive estimate of his remedy.

Brinton W. *The diseases of the stomach.* London: John Churchill, 1859:387

Submitted by Jeremy Hugh Baron, honorary professorial lecturer, Mount Sinai School of Medicine, New York