

# School feeding in Jamaica: a review of its evaluation<sup>1,2</sup>

Donald T Simeon

**ABSTRACT** This paper reviews two studies that evaluated the school feeding program in Jamaica. The first examined 115 children aged 12–13 y who were enrolled in three classes in a poor, rural school. One class was served the standard school meal at 0900 whereas the other two classes served as controls. The outcome variables included school achievement, attendance, and weight gain. After one semester, the class receiving the meal showed improved arithmetic scores and school attendance compared with the control classes; however, they showed no weight gain. The academic improvement remained significant after school attendance was controlled for. It was therefore hypothesized that the gains in arithmetic resulted from the alleviation of hunger in the classroom. The other study, conducted in a metabolic ward, examined the effects of missing breakfast on cognitive function in 90 children aged 9–10 y and of differing nutritional status. Using a crossover design, the investigators tested each child on two mornings 1 wk apart, once after serving them breakfast and second without. Breakfast, consisting of the school program meal, was served at 0800. When severely malnourished, stunted, or wasted children received no breakfast, their performance in various cognitive tests deteriorated. These results indicate that alleviation of hunger was one of the mechanisms by which school feeding improved academic achievement in the previous study. Undernourished children are more likely to benefit from school feeding programs than are adequately nourished children. *Am J Clin Nutr* 1998;67(suppl):790S–4S.

**KEY WORDS** School feeding, fasting, breakfast, cognition, Jamaica, weight gain, children

## INTRODUCTION

Underachievement in schools is a major problem and is most prevalent in developing countries such as Jamaica. The numerous causes of underachievement include poor quality of teaching, unavailability of textbooks, parental resistance to formal education, and low attendance rates. Poor nutrition may also be an important factor in Jamaica because studies have associated undernutrition with poor school achievement and low attendance rates. Children with lower scholastic attainment were more poorly nourished than higher achievers (1).

School feeding programs have operated in Jamaica for decades, and in 1973 the government implemented a structured program that was expected to benefit both school achievement and attendance. Because the program did not include a method for determining whether its educational objectives were met, an

evaluation was warranted. The two studies conducted for this evaluation are described below.

## STUDY 1

The first study examined the effects of the Jamaican school meal on achievement, attendance, and physical growth (2). The evaluation was conducted among children enrolled in grade 7 in a rural school that was not a participant in the school meal program. The grade 7 children were first divided into 10 classes based on scholastic ability. Those in the three lowest classes were selected for the evaluation, following the assumption that these children were most likely to benefit from the program. They were also the group with the lowest school attendance rates and the highest prevalence of undernutrition. Almost half of these children (who were aged 12–13 y) were undernourished according to the Wellcome classification, ie, weight-for-age <80% of the reference standard.

School achievement was measured by using the Wide Range Achievement Test (3), which included arithmetic, spelling, and reading subtests. Weight and height were measured with standard techniques and school attendance rates were obtained from class registers.

Of the three groups, the children in class 1 received the school meal ( $n = 44$ ), those in class 2 received a syrup drink ( $n = 33$ ), and those in class 3 received nothing ( $n = 38$ ). The school meal consisted of 100 mL milk (544 kJ) and either a slice of cake (1046 kJ) or a meat-filled pastry (2510 kJ), which was given  $\approx 35\%$  of the time. The two classes that received either the syrup (130 kJ) or nothing served as control groups. The school meal was served as breakfast at 0900.

In this longitudinal study, the children were followed over two semesters. The first semester was used as a baseline and the intervention was given during the second semester only. Measurements were taken three times: at the start of the first semester (September) and at the start (January) and end (March) of the second semester. Because many of the factors affecting school performance and physical growth are difficult to identify and measure, the study was designed to take these confounders into account by measuring the

<sup>1</sup> From the Commonwealth Caribbean Medical Research Council, Port-of-Spain, Trinidad and Tobago.

<sup>2</sup> Address reprint requests to DT Simeon, CCMRC, 16-18 Jamaica Boulevard, PO Box 164, Port-of-Spain, Trinidad and Tobago. E-mail: ccmrc.ds@trinidad.net.

change in the outcome variables during the first semester and controlling for them in the analyses. However, because of time constraints, no reading or height data were collected at the start of the second semester. It was therefore not possible to analyze the effects of the intervention on these two variables.

To determine whether the school meals had beneficial effects on the various outcome measures, the data were analyzed by multiple regression. The dependent variables in these analyses were the measures at the end of the second semester. The independent variables were those at the start of the first and second semesters (to control for changes during the first semester): sex, age, and treatment group. In comparing the two control groups initially, the evaluators found no significant differences between the groups in any of the outcome measures. For this reason they combined the control groups and compared them with the class receiving the school meal to determine the effects of the meal.

The spelling and arithmetic test scores for class 1 and the control group (classes 2 and 3) are shown in **Figure 1**. The difference between groups in spelling scores was not statistically significant. However, class 1 performed better on the arithmetic test than the control group ( $P < 0.01$ ). School attendance also showed a significant treatment effect ( $P < 0.01$ ). Although attendance rates dropped in the second semester for both groups, the drop was significantly less for class 1 than for the control group (Figure 1). There was no difference in weight gain between the class 1 children and the control group (Figure 1).

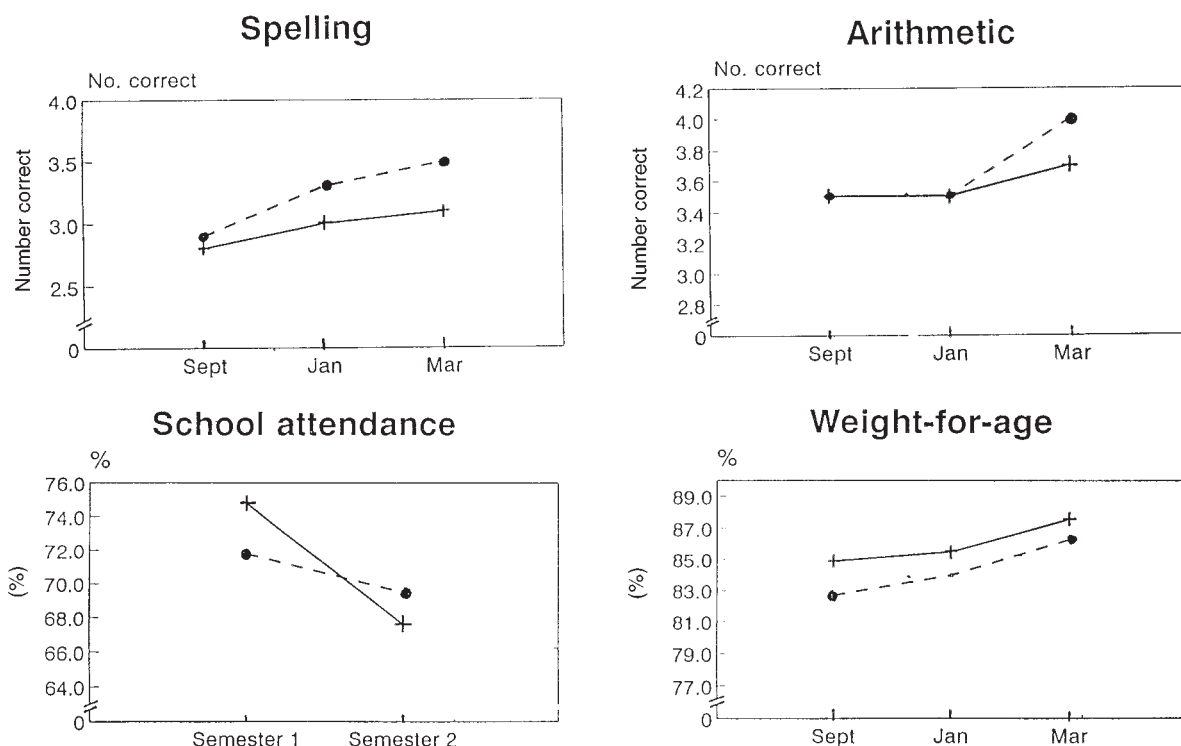
In summary, the provision of breakfast to Jamaican school-children in grade 7 for one semester resulted in higher school attendance and greater achievement in arithmetic. One reason for low school attendance is poverty; children in Jamaica often attend school with a lunch or money to purchase lunch, and if neither is

available, they may be kept at home. It is therefore plausible that the provision of meals encourages children to attend school more regularly. The children who received the school breakfast did not gain weight during the semester. The results of additional statistical analyses indicate that, with improved school attendance controlled for, the gains in arithmetic were still significant. The implication is that the provision of the meal resulted in improved scholastic achievement, which was independent of school attendance and weight gain. It was therefore hypothesized that the alleviation of hunger during school hours was a valid reason for the improvement in arithmetic.

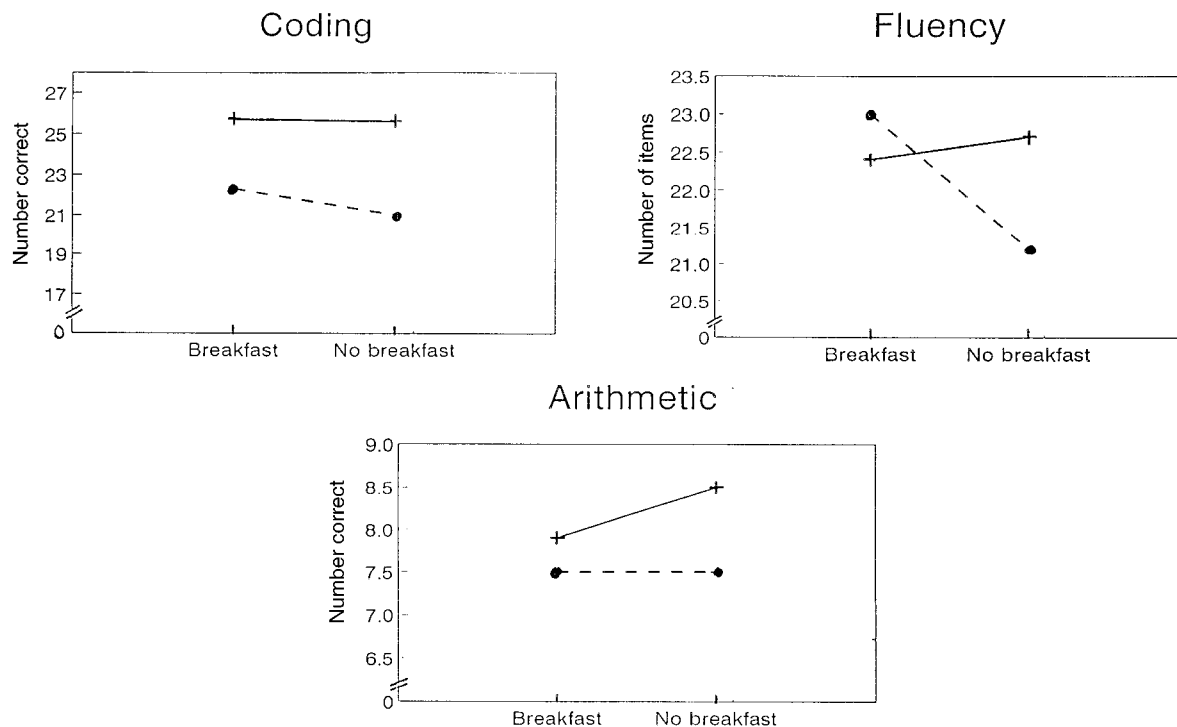
## STUDY 2

The second study in the evaluation examined the effects of hunger, ie, short-term food deprivation, on the cognition of school-children (4). The goal of this study was to determine whether the omission of breakfast adversely affected the cognitive function of undernourished and adequately nourished children.

Three groups of children, aged 9–10 y, served as study subjects. The first group had been hospitalized for severe malnutrition during their first 2 y of life; the second group of children were stunted (height-for-age  $z$  scores  $< -2.0$ ); and the third group of children were nonstunted (height-for-age  $z$  scores  $> -1.0$ ). Studies have found that children who were once severely malnourished perform at lower levels of scholastic achievement and have more behavioral problems than children who have never been severely malnourished (5). Investigators for study 2 included this group of children under the assumption that such children are particularly vulnerable to short-term food deprivation. They included stunted children because stunting is the most prevalent consequence of



**FIGURE 1.** Mean scores on the spelling and arithmetic tests and values for school attendance and weight-for-age (% of the median) for the class receiving the school meal (● - - - ●) and the control group (+ — +). The class receiving the meal had significant benefits when compared with the control group in arithmetic ( $P < 0.01$ ) and school attendance ( $P < 0.01$ ). Data are from reference 2.



**FIGURE 2.** Mean coding, fluency, and arithmetic test scores in the breakfast and no breakfast states for the malnourished (● - - - ●) and nonstunted (+ — +) groups. The malnourished children had significantly lower scores on coding ( $P < 0.05$ ) and fluency ( $P < 0.001$ ) tests when they had no breakfast. In contrast, the nonstunted children had improved performance in arithmetic when they had no breakfast ( $P < 0.001$ ). Data are from reference 4.

long-term malnutrition in developing countries and, as such, was used in this study to define undernutrition.

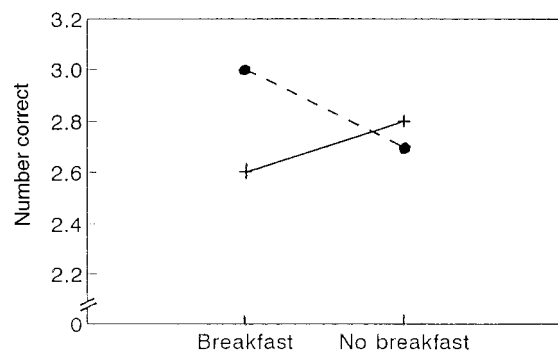
The investigators used hospital records to identify previously severely malnourished children and recruited the other two groups from primary schools. They identified the stunted children first, and then matched nonstunted children with them by sex, age, class, and area of residence. There were 30 children in each of the three groups.

The cognitive battery consisted of seven tests, including three subtests of the revised Wechsler Intelligence Scale for Children (6): mental arithmetic, digit span (auditory short-term memory), and coding (visual short-term memory) tests. The verbal fluency (retrieval from long-term memory) and listening comprehension tests were obtained from the Clinical Evaluation of Language Functions (7). The other two tests, Matching Familiar Figures test (MFFT) (8) and Hagen's Central Incidental Task (9), were known to be sensitive to the effects of short-term food deprivation in North American children (10). The Central Incidental Task test measured visual short-term memory and attention, and the MFFT measured impulsiveness and problem-solving efficiency (11). The efficiency score was obtained by summing the  $z$  scores of the number of errors and the latency time before responding. Therefore, a low efficiency score was indicative of a more efficient performance, ie, fewer errors and a quicker response time.

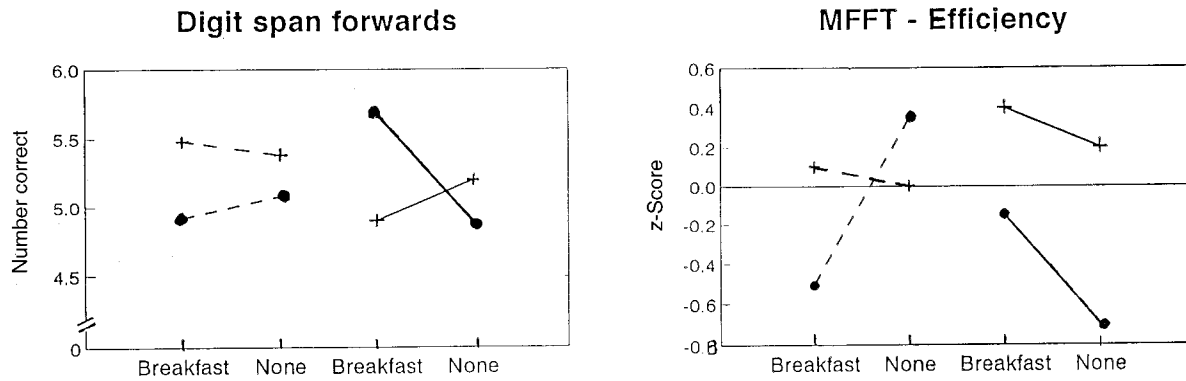
The Peabody Picture Vocabulary test (12) was used to measure the children's intelligence quotient. This measure was included because intelligence quotient was previously found to modify the effects of food deprivation on cognition (8). Another potentially confounding variable was the children's usual breakfast intake. It is possible that the effects of breakfast omission would not be the same in children who normally had little or no

breakfast as for those who normally ate a substantial breakfast. The mean of breakfast recalls from 3 d was used to estimate the children's usual breakfast intake.

The study used a crossover design, with each child serving as his or her own control. The subjects were admitted on two evenings, 1 wk apart, to a metabolic ward, where they received dinner at 1700. They ate nothing else until 0800 the following morning, when they were served either a full breakfast or a cup of tea sweetened with aspartame. Half of the subjects were randomly assigned to receive breakfast on the first visit and tea on the second, and vice versa for the other half. The standard breakfast, from the Jamaican school feeding program, supplied 2468 kJ, or 25% of a child's daily dietary requirements. At 1100 on



**FIGURE 3.** Mean scores on the digit-span-backward test for the wasted (● - - - ●) and nonwasted (+ — +) children. The wasted children had significantly lower scores when they had no breakfast ( $P < 0.05$ ). Data are from reference 4.



**FIGURE 4.** Significant treatment-by-group-by-wasting interactions on the digit-span-forward test ( $P = 0.01$ ) and the Matching Familiar Figures test (MFFT;  $P = 0.02$ ). ● - - - ●, wasted and malnourished; + - - +, nonwasted and malnourished; ● — ●, wasted and nonstunted; + — +, nonwasted and nonstunted. On the digit-span-forward test, the wasted, nonstunted children had significantly lower scores when they had no breakfast ( $P < 0.02$ ), whereas the nonwasted, nonstunted children had higher scores ( $P < 0.05$ ). Performance on the MFFT declined significantly for the wasted, malnourished children when they had no breakfast ( $P < 0.001$ ). Data are from reference 4.

both visits a trained tester, blind to the subjects' treatment status, administered a series of cognitive tests, after which the children were served lunch and returned home.

To test the effects of breakfast on cognition, the investigators analyzed the data by using analyses of covariance with repeated measures. The dependent variables were the children's cognitive test scores on the first and second visits. The covariates were the potentially confounding variables, such as the children's intelligence quotient and their usual breakfast intake. The factors were nutritional group and the order in which they received breakfast. Because the previously severely malnourished and the stunted groups showed no differences in any of the cognitive test scores after fasting (omitting breakfast), they were combined and compared with the nonstunted group to examine treatment-by-group interactions.


Not unexpectedly, there were no overall treatment effects for any of the cognitive tests. The treatment-by-group interaction was not significant for the coding test, but the main effect of treatment was nearly significant ( $P < 0.08$ ). The combined undernourished groups showed a significant decline in performance on the coding test after fasting ( $P < 0.05$ ), but the nonstunted group showed no such effect (Figure 2).

There were significant treatment-by-group interactions in the verbal fluency and mental arithmetic tests ( $P = 0.04$  in each case). Performance on the fluency test was poorer for the undernourished groups when breakfast was omitted ( $P < 0.001$ ), but fasting had no such effect on the nonstunted group. Unexpectedly, the latter group performed better in arithmetic after fasting ( $P < 0.001$ ), whereas the omission of breakfast made no difference in this test for the undernourished group. The treatment-by-group interactions for verbal fluency and mental arithmetic are shown in Figure 2.

Because wasting is also a measure of undernutrition, particularly short-term dietary inadequacy, the investigators decided to examine whether wasting was important to the children's response to missing breakfast. They divided the sample into wasted (weight-for-height  $< 90\%$  of the reference standards) and nonwasted subsets and examined treatment-by-wasting interactions. The only significant treatment-by-wasting interaction was for the digit-span-backwards test ( $P = 0.04$ ). The wasted children had lower scores after missing breakfast ( $P < 0.05$ ), whereas the nonwasted children showed no such effect (Figure 3).

There were significant treatment-by-group-by-wasting interactions for the digit-span-forward test and the MFFT ( $P = 0.01$  and  $P = 0.02$ , respectively). Among the nonstunted children, those who were wasted had lower scores on the digit-span-forward test after missing breakfast ( $P < 0.02$ ), whereas those who were not wasted had higher scores ( $P < 0.05$ ). There were no differences in the digit-span-forward test scores between the fed and the fasted states for either the wasted or the nonwasted subjects in the combined undernourished group. On the other hand, the wasted subjects in this group had lower scores on the MFFT when breakfast was omitted ( $P < 0.001$ ). Fasting had no effect on MFFT scores for either nonwasted or nonstunted subjects. The treatment-by-group-by-wasting interactions for these two cognitive tests are shown in Figure 4.

In summary, the omission of breakfast effected a decline in performance on the verbal fluency and coding tests for both the stunted and the previously severely malnourished children, and a similar decline on the digit-span-backward test for the wasted children. In addition, fasting had adverse effects on MFFT performance for the wasted members of the stunted and severely malnourished groups as well as on performance on the digit-span-forward test for the wasted members of the nonstunted group. Unexpectedly, fasting was accompanied by improved performance in mental arithmetic tasks among the nonstunted children and on the digit-span-forward test among the nonwasted, nonstunted children.

In conclusion, the omission of breakfast had adverse effects on the cognitive functioning of poorly nourished children. It is therefore likely that alleviating hunger helped improve school achievement in study 1 (2). The results of these two Jamaican studies indicate that programs that alleviate hunger in schools are likely to produce improvements in school achievement. Undernourished children are expected to benefit more from these programs than children who are adequately nourished. 

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