The Relationship of School Breakfast to Psychosocial and Academic Functioning

Cross-sectional and Longitudinal Observations in an Inner-city School Sample

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Objective: To determine if a relationship exists between participation in a school breakfast program and measures of psychosocial and academic functioning in school-aged children.

Methods: Information on participation in a school breakfast program, school record data, and in-depth interviews with parents and children were collected in 1 public school in Philadelphia, Pa, and 2 public schools in Baltimore, Md, prior to the implementation of a universally free (UF) breakfast program and again after the program had been in place for 4 months. One hundred thirty-three low-income students had complete data before and after the UF breakfast program on school breakfast participation and school-recorded measures, and 85 of these students had complete psychosocial interview data before and after the UF breakfast program. Teacher ratings of behavior before and after the UF breakfast program were available for 76 of these students.

Results: Schoolwide data showed that prior to the UF breakfast program, 240 (15%) of the 1627 students in the 3 schools were eating a school-supplied breakfast each day. Of the 133 students in the interview sample, 24 (18%) of the students ate a school-supplied breakfast often, 26 (20%) ate a school-supplied breakfast sometimes, and 83 (62%) ate a school-supplied breakfast rarely or never. Prior to the UF breakfast program, students who ate a school-supplied breakfast often or sometimes had significantly higher math scores and significantly lower scores on child-, parent-, and teacher-reported symptom questionnaires than children who ate a school-supplied breakfast rarely or never. At the end of the school term 4 months after the implementation of the UF breakfast program, school-supplied breakfast participation had nearly doubled and 429 (27%) of the 1612 children in the 3 schools were participating in the school breakfast program each day. In the interview sample, almost half of the children had increased their participation. Students who increased their participation in the school breakfast program had significantly greater increases in their math grades and significantly greater decreases in the rates of school absence and tardiness than children whose participation remained the same or decreased. Child and teacher ratings of psychosocial problems also decreased to a significantly greater degree for children with increased participation in the school breakfast program.

Conclusion: Both cross-sectional and longitudinal data from this study provide strong evidence that higher rates of participation in school breakfast programs are associated in the short-term with improved student functioning on a broad range of psychosocial and academic measures.

Arch Pediatr Adolesc Med. 1998;152:899-907

Editor's Note: Here we have more data to prove that your mother was correct about the importance of eating a good breakfast.

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MANY STUDIES[1-3] have demonstrated the negative effects of severe malnutrition on early childhood development and functioning, and a number of reports[4-7] have documented that chronic malnutrition negatively affects children's social, emotional, and cognitive functioning. For example, undernourished children, as defined by clinical and diet history and anthropometry, tend to be less active, more dependent on adults, and more anxious, interacting less with others and showing less affect than their better-nourished peers.[4,5] Studies[8-14] of the cognitive effects of nutritional deprivation have also demonstrated deficits in attention and working memory as a result of inadequate nourishment and

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PATIENTS AND METHODS

STUDY POPULATION AND SAMPLING

Data for the current analyses came from a collaborative study of a free breakfast program in the public schools of Philadelphia, Pa, and Baltimore, Md. Students and their parents from 3 inner-city schools (1 in Philadelphia and 2 in Baltimore) were assessed on a variety of academic, psychosocial, and food sufficiency or hunger measures before the start of a UF breakfast program in the schools. In Philadelphia, the school district took advantage of Provision 2 of the US Department of Agriculture school meal guidelines, which permit schools to provide UF meals to all students in low-income areas under certain conditions.[24] More than 150 other schools had already implemented universal feeding. In Baltimore, a local foundation underwrote the added cost of making school breakfast free to all students who were not covered through standard federal reimbursement.

The regular school breakfast was available to all students using the conventional payment categories of free, reduced, and full-price meals during the first semester. At the beginning of the second semester, the same school breakfast that all other students in the school system received was made available for free to all students in these 3 schools. For the present study, students and their parents were interviewed in late January or early February prior to the start of the UF breakfast program and then again in late May to early June after the program had been running for nearly 4 months. In the 3 schools, only children in grade 3 and higher were invited to participate in the study, although all children from all grades were eligible for a free breakfast. Two schools included kindergarten through sixth grade and the third school included kindergarten through eighth grade. Only students in the third grade and higher were interviewed, since that is the minimum age required for some of the child measures.

The parents of all 126 students in the fourth and fifth grades in the Philadelphia school and the parents of all 367 students in the third through eighth grades in the 2 Baltimore schools were invited to participate in the study through letters that were sent home with students. After an additional invitation letter and follow-up phone calls, 220 (45%) of the 493 students agreed to participate. When interviews were scheduled, 51 parents who initially agreed to participate could not be scheduled for an interview, leaving a combined sample of 169 interviews with parents and children before the UF breakfast program (169 [77%] of the 220 students who agreed to participate and 169 [34%] of the 493 students in the total sample). Before the UF breakfast program, records of individual student school breakfast participation were available for 79% of the 169 children, resulting in a sample of 133 students with complete parent and/or child measures, school records, and staff reports of participation before the UF breakfast program.

Parents and children were subsequently reinterviewed about 4 months after the initial interviews. In Philadelphia, the parents of 55 of the 59 students who had participated in the initial school breakfast interview were sent invitation letters and were called to set up another interview (4 students had moved). In Baltimore, because of time and financial constraints, the study design called for only 55 subjects (half of the sample of 110) to be reinterviewed. In these 2 schools, children were randomly sampled from the 3 original breakfast program participation groups (rarely, sometimes, or often) in an effort to match the prevalence rate of participation in the school breakfast program in the reinterview sample.

Of the 110 children (55 in Baltimore and 55 in Philadelphia) who were invited for reinterviews, 62 (57%) rarely ate the school breakfast, 30 (27%) ate the school breakfast sometimes, and 18 (16%) ate the school breakfast often. The parents of 102 (93%) of these children agreed to be reinterviewed. When interviews were scheduled, 12 of the parents who initially agreed to participate could not be scheduled, leaving a final post–UF breakfast program interview sample of 90 parents and children (88% of the agreeing sample and 82% of parents who were recontacted). Of these 90 subjects, 5 children (6%) had incomplete post–UF staff-reported breakfast program participation records, resulting in a post–UF breakfast program participation interview sample of 85 parents and children with complete data. There were no differences in grade level, ethnicity, sex, parental marital status, or fall-term grades between the initial sample and the reinterview sample.

In all schools, a variety of informational and promotional methods were used to make parents and children aware of the UF breakfast program and to encourage student participation. The study was approved by the Subcommittee on Human Studies at the Massachusetts General Hospital, Boston, and by the research committees of the Philadelphia and Baltimore public schools. Participation by parents and children was voluntary and access to school records was made possible through separate consent signed by parents and students.

PARTICIPATION BEFORE AND AFTER THE UF SCHOOL BREAKFAST PROGRAM

School breakfast participation was recorded on site by school cafeteria staff who wrote down the names of all children who took a school breakfast in the cafeteria each day for the week prior to the start of the UF breakfast program (the last week in January or first week in February) and again during the last week in May when the program had been running for almost 4 months. These 2 index weeks were taken as samples of participation before and after the UF school breakfast program.

For each student, the school breakfast participation rate was calculated by dividing the number of days the student had taken the breakfast at school divided by the number of days the student was coded as being present at school in the official school record. Children were considered to participate often if they ate breakfast 80% or more of days present. Children were considered to participate sometimes if they ate between 20% and 79% of days present. Students who ate less than 20% of the time were classified as rarely participating in the school breakfast program.

Although we do not know for sure that the students actually ate their breakfasts, the research team observed that most of the students ate most of the components of their meals. While

more serious deficits in intelligence scores over the long-term as a result of early and serious malnourishment.[2,3,15] Until recently, however, the prevalence and effects of chronic mild-to-moderate undernutrition, defined as food insufficiency or the experience of hunger, have not been well documented.

the exact nutritional composition of the meals consumed is not known, all school breakfasts in both school districts were designed by dietitians and had to provide (if they were to be reimbursed by the US Department of Agriculture) nutritionally balanced meals that met the US Department of Agriculture's guidelines on a daily basis. Meals typically included milk, cereal, bread or a muffin, and fruit or juice.

CHANGE IN PARTICIPATION AFTER UF SCHOOL BREAKFAST PROGRAM

The present study used the change in the rate of school breakfast participation (rate at the end of the school term minus the rate at the beginning of the study) as an indication of the change in the consumption of school meals. Children were classified as increased school breakfast participants if their rates increased by 20% or more over the rate they participated prior to the implementation of the UF breakfast program. Children were considered to have the same school breakfast participation rate if their rates after the UF breakfast program ranged ±19% of their rates before the UF breakfast program. Children were considered to be decreased school breakfast participants if their participation rate declined by 20% or more.

BACKGROUND FACTORS

Each child's grade level, ethnicity, sex, and parental marital status were assessed during the initial interviews with parents. Each child's hunger was assessed through the standard 8-item parent questionnaire developed by the CCHIP.[17] The CCHIP scale assesses the child's and the family's experiences of food insufficiency and hunger. When 5 or more indicators are present the child or family is classified as "hungry." Positive answers on 1 to 4 questions lead to a classification of "at risk for hunger," and families in which there are no yes answers are considered "not hungry." Validity and reliability of the scale have been documented in recent studies.[19,29]

SCHOOL-RECORDED MEASURES

The students' grades in math, science, social studies, and reading and their absence and tardiness rates were collected for fall and spring terms from official school records. Letter grades were converted into numerical values based on a 4.0 grading system.

CHILD-REPORTED INTERVIEW MEASURES

Children's Depression Inventory

The Children's Depression Inventory[30] (CDI) is a 27-item questionnaire designed to measure depressive symptoms in school-aged children. It is one of the most widely used depression inventories and has normative data.[31] For each item, children are asked to mark 1 of 3 statements that best describes their behavior and/or feelings during the previous 2 weeks (scored 0, 1, or 2). Total CDI scores were used in the analyses of the relationship between depression and the rates of school breakfast participation.

Revised Children's Manifest Anxiety Scale

The Revised Children's Manifest Anxiety Scale[32] (RCMAS) is a 28-item checklist that assesses symptoms of anxiety in school-aged children. It has been validated in children from a variety of socioeconomic levels.[32,33] Children are asked whether statements are true or false about them. Total RCMAS scores were used in the analyses.

PARENT-REPORTED INTERVIEW MEASURES: PEDIATRIC SYMPTOM CHECKLIST

The Pediatric Symptom Checklist (PSC) is a brief, widely used, parent-completed questionnaire that has been validated as a screening measure to identify children with psychosocial dysfunction.[34-36] The PSC consists of 35 items that are reported "never," "sometimes," or "often" present and scored 0, 1, or 2, respectively. A total score is obtained by adding the scores for each of the items.

TEACHER-REPORTED MEASURES: CONNERS' TEACHER RATING SCALE-39

For each participating child in the Baltimore subsample, teacher-completed evaluations of child behavior were collected before the UF breakfast program began and again at the end of May. The Conners' Teacher Rating Scale-39 (CTRS-39)[37] is one of the most widely used teacher-reported symptom checklists. It consists of 39 items that assess hyperactivity and other behavioral problems in school-aged children. Teachers check each item as "not at all present," "just a little present," "pretty much present," or "very much present" with numerical scoring weights of 0, 1, 2, and 3, respectively. Although there are 7 subscales on the CTRS-39, the most frequently used scale to assess behavioral problems and the one that is recommended for assessing behavioral change over time is the Hyperactivity Index. The CTRS-39 Hyperactivity Index is based on a subset of 10 items and has been demonstrated to be a valid and useful assessment tool.[37,38] Total scores on the CTRS-39 Hyperactivity Index have been shown to correlate reliably with the amount of observed motor activity in the classroom among normal school-aged children[39] as well as ratings of excessive talking.[40] Only the CTRS-39 Hyperactivity Index scores are reported herein because the other scores did not demonstrate statistically significant effects. For the CTRS-39, RCMAS, CDI, and PSC, higher scores indicate worse functioning.

STATISTICAL METHODS

The goal of our data analyses was to examine the association between our breakfast participation variables and demographic factors and child adjustment scores. Because the distributions of most of our variables were not appropriate for the normal theory linear model, we used ordinal logistic regression, which modeled our ordinal breakfast participation variables as a function of our child adjustment measures.

A recent report by the Community Childhood Hunger Identification Project (CCHIP)[16] has provided epidemiological data from 11 states suggesting that 8% of American children younger than 12 years experience persistent episodes of food insufficiency and hunger and that an additional 20% are at risk for these conditions. The

CCHIP reports[16,17] also document that a family's low income is the strongest predictor of food insufficiency and hunger, which in turn are also associated with parents' reports of their children's mood and concentration problems and absence from school. Two recent studies[18,19] have provided the first-ever documentation of the relationship between periodic, persistent food insufficiency as measured by CCHIP and objective measures of psychosocial and academic dysfunction, as well as of the validity and reliability of the CCHIP measure.[16] The relationship between the broader category of poverty and psychosocial dysfunction in children has long been known and is well documented.[20]

The possibility that some of the negative effects of chronic, intermittent undernutrition in children in the United States could be reversed through school feeding programs is one of the most important justifications for the national school lunch and breakfast programs.[21,22] Although the National School Lunch Program has been shown to be very successful in supporting the nutrient requirements of nutritionally at-risk children, the benefits of the National School Breakfast Program have not been well documented.[13] Although nearly 60% of the nation's elementary school students participate in the school lunch program, less than one third of these children participate in the school breakfast program. Even among poor and low-income children, most of whom are entitled to free school meals, participation is less than 25%.[21,23]

While the large disparity between the participation rates in school breakfast and lunch programs suggests the possibility for improvement, a decade of efforts to increase participation in the school breakfast program by child nutrition advocates have resulted in only moderate gains and the lack of larger increases has remained a puzzle.[23] The stigma of having to ask for free meals has frequently been hypothesized to be a major barrier, and providing universally free (UF) meals has been proposed as a way of increasing participation by removing this stigma by having all children eat for free.[24]

The National School Breakfast Program was established in 1966 by Congress under the Child Nutrition Act to provide breakfast to low-income children. Although nutritional gains in participating children have not been documented for the National School Breakfast Program,[13] recent studies from both Peru[25] and Jamaica[26] have shown significant beneficial effects of breakfast provided in school and at home on school attendance and cognitive performance, particularly among nutritionally at-risk children. A recent report[27] of a free school breakfast program in Rhode Island documented that children who participated in the school breakfast program had significantly lower rates of absence and consumed more nutritious breakfasts than nonparticipants. This study[27] replicated results of decreased absences and tardiness found in the study by Meyers et al,[28] in Lawrence, Mass, a decade ago, which also documented that significant improvements in academic functioning were related to participation in a school breakfast program.

While these studies have increased the understanding of the cognitive and educational benefits of school breakfast programs, the benefits of school breakfast to children's emotional or behavioral functioning remain largely undocumented as does the link between increases in participation in school breakfast programs and improved academic and behavioral functioning on an individual student basis. In this study, we address both these questions through an examination of the relationship between participation in a school breakfast program and several measures of academic performance and psychosocial functioning.

RESULTS

Since preliminary analyses showed that the socioeconomic and ethnic characteristics of the children were similar in all 3 schools (all 3 had more than 70% of the students eligible for free or reduced-price meals, and all had more than 70% African American students), the subsamples were combined for all subsequent analyses. In the combined sample, 384 (78%) of the children were in elementary grades (3-5) and 108 (22%) were in middle school grades (6-8). The mean (SD) age of the sample was 10.3 (1.6) years. Just under half of the sample was male (58 [44%]) and from single-parent households (60 [45%]). One hundred-eleven (83%) were from African American backgrounds. There were no statistically significant differences between these groups in terms of rates of participation before the UF school breakfast program. Forty-four (33%) of the children came from families whose parents reported that their children were hungry (13 [10%]) or at risk for hunger (31 [23%]) on the CCHIP[17] measure.

BEFORE PARTICIPATION IN UF SCHOOL BREAKFAST PROGRAM

Background Characteristics

Prior to the introduction of the UF breakfast program, the average daily school breakfast participation in the 2 Baltimore schools was 14% (61/432) and 26% (84/322), while in the Philadelphia school the rate was 11% (95/873). When the data from all the students were pooled, the mean rate of participation before the UF breakfast program for the 3 schools was 15% (240/1627) of days present. Of the 133 students in the study sample, 83 (62%) of the children were classified as eating school breakfast rarely or never, 26 (20%) as eating school breakfast sometimes, and 24 (18%) as eating school breakfast often (**Table 1**). Children in the 3 pre–UF breakfast program participation groups did not differ significantly with respect to sex, parental marital status, or race. Hungry and at-risk children were slightly, but not significantly, more likely to participate in the school breakfast program than nonhungry children (57 [43%] vs 46 [35%], respectively). The converse of this finding is that more than half (25 [57%]) of the hungry or at-risk children participated in school breakfast only rarely or never. In this sample, middle school students were significantly more likely to participate in the school breakfast program compared with elementary school students (13 [45%] of 29 vs 31 [30%] of 104) ($z = 3.4$; $P = .001$).

Table 1. Background Characteristics and School Breakfast Program Participation Groups

Characteristics	Total No. (%) of Children	School Breakfast Program Participation Groups, No. (%)		
		Rarely	Some	Often
No.	133 (100)	83 (62)	26 (20)	24 (18)
Grade level				
Elementary (grades 3-5)	104 (83)	79 (70)	17 (16)	14 (14)
Middle (grades 6-8)	29 (22)	16 (55)	6 (21)	7 (24)*
Sex				
Male	58 (44)	36 (62)	12 (21)	10 (17)
Female	75 (56)	47 (63)	14 (19)	14 (19)
Parental marital status				
Nonsingle	73 (55)	46 (63)	11 (15)	16 (22)
Single	60 (45)	37 (62)	15 (25)	8 (13)
Race				
African American	111 (83)	71 (64)	25 (23)	15 (14)
White	22 (17)	12 (55)	1 (5)	9 (41)
CCHIP status†				
Not hungry	89 (67)	58 (65)	15 (17)	16 (18)
Hungry or at risk	44 (33)	25 (57)	11 (25)	8 (18)

*P<.01.
†CCHIP indicates Community Childhood Hunger Identification Project.[29]

Table 2. Mean Child Adjustment Scores for School Breakfast Program Participation Groups Before Universal Feeding*

Measure	Scores			
	Total No. of Children	School Breakfast Program Participation Groups		
		Rarely	Some	Often
School recorded				
No. (%)	133 (100)	83 (62)	26 (20)	24 (18)
Math grade†	2.3	2.1	2.3	3.0
Days absent	1.5	1.5	1.6	1.4
Days tardy	0.5	0.6	0.4	0.1
Interview				
No. (%)	85 (100)	27 (32)	39 (40)	19 (22)
CDI total score†	6.4	7.9	4.5	3.4
RCMAS total score†	10.1	11.4	8.3	7.2
PSC total score‡	17.2	18.9	14.7	13.9
Teacher reported				
No. (%)	76 (100)	41 (54)	15 (20)	20 (26)
CTRS-39 score	58.4	63.3	57.3	49.1

*Grades are expressed on a 4.0 scale (A = 4.0). CDI indicates Child Depression Inventory[30]; RCMAS, Revised Children's Manifest Anxiety Scale[32]; PSC, Pediatric Symptom Checklist[34]; and CTRS-39, Connors' Teacher Rating Scale-39,[37] Hyperactivity Index (Baltimore, Md, sample only).
†P<.001.
‡P<.01.

School-Recorded Measures

Math Grades. Students' grades in math were related to participation in the school breakfast program before the UF breakfast program began, although their grades in science, social studies, and reading were not related. As shown in **Table 2**, during the fall term prior to the UF breakfast program, children who did not participate in the school breakfast at all or who participated in school breakfast sometimes had significantly lower math grades than those who participated in school breakfast often ($z = 3.4$; $P = .001$).

Absence and Tardy Rates. During the fall term prior to the UF breakfast program, children who participated in school breakfast rarely or sometimes were absent from and late to school more days than children who participated in school breakfast often, although the differences were not statistically significant (Table 2).

Interview Measures

As shown in Table 2, the mean child report of depression (CDI) score for children classified as participating in school breakfast rarely was significantly higher (worse; mean, 7.9) than for children who participated in school breakfast sometimes (mean, 4.5) or often (mean, 3.4) ($z = 3.5$; $P = .001$). The mean child report of anxiety (RCMAS) score for children classified as rarely participating in school breakfast (11.4) was significantly higher than the mean for children who participated in school breakfast sometimes (8.3) or often (3.2) ($z = 3.2$; $P = .001$). The mean parent report of psychosocial symptoms (PSC) score for children who rarely ate school breakfast was significantly higher (18.9) than it was for children who ate school breakfast sometimes (14.7) or often (mean, 13.9) ($z = 2.7$; $P = .007$).

Hyperactivity

The mean CTRS-39 Hyperactivity Index *t* score for children (Baltimore only) classified as eating school breakfast rarely (Table 2) was significantly higher (63.3) than for children who ate school breakfast sometimes (57.3) or often (49.1) ($z = 2.5$, $P = .02$).

AFTER PARTICIPATION IN UF SCHOOL BREAKFAST PROGRAM

Following the implementation of the UF breakfast program, the mean daily school breakfast participation in the 2 Baltimore schools increased to 104 (24%) of 426 and 148 (47%) of 318, while in the Philadelphia school the increase in participation was 177 (20%) of 868. The daily mean for the 3 schools combined rose significantly from 240 (15%) of 1627 students to 429 (27%) of 1612 students ($F_2 = 32.5$; $P<.001$). In the study sample, the rate of children who ate school breakfast often rose from 18% (24/133) to 24% (32/133), and the rate of children who ate school breakfast rarely declined from 62% (83/133) to 43% (57/133).

School-Recorded Measures

Math Grades. At the time of the follow-up assessments, the spring-term math grades were significantly related to school breakfast participation in May (**Table 3**). Children who ate school breakfast rarely had a mean math grade of 1.9 compared with 2.0 for children who ate school breakfast sometimes and 2.8 for children who ate school breakfast often ($z = 2.5$; $P = .01$).

Absence and Tardy Rates. Children who ate school breakfast rarely were absent from school significantly more (2.8

Table 3. Mean Child Adjustment Scores for School Breakfast Program Participation Groups After Universal Feeding*

Measure	Scores: Total No. of Children	School Breakfast Program Participation Groups: Rarely	Some	Often
School recorded				
No. (%)	133 (100)	57 (43)	44 (33)	32 (24)
Math grade†	2.2	2.0	2.0	2.8
Days absent	2.2	2.8	1.9	1.5
Days tardy†	0.6	1.2	0.1	0.4
Interview				
No. (%)	85 (100)	27 (32)	39 (46)	19 (22)
CDI total score	6.2	6.8	6.8	4.2
RCMAS total score	7.8	7.2	8.4	7.3
PSC total score	15.7	17.2	15.2	14.7
Teacher reported				
No. (%)	76 (100)	33 (43)	22 (29)	21 (28)
CTRS-39 score†	53.8	58.3	53.4	47.3

**Grades are expressed on a 4.0 scale (A = 4.0). CDI indicates Child Depression Inventory[30]; RCMAS, Revised Children's Manifest Anxiety Scale[32]; PSC, Pediatric Symptom Checklist[34]; and CTRS-39, Connors' Teacher Rating Scale-39,[37] Hyperactivity Index (Baltimore, Md, sample only).*
†P<.01.

Table 4. Mean Changes in Child Adjustment Scores for School Breakfast Program Participation Groups Before and After Universal Feeding*

Measure	Scores: Total No. of Children	School Breakfast Program Change in Participation Groups: Decrease	Same	Increase
School recorded				
No. (%)	133 (100)	28 (21)	49 (37)	56 (42)
Math grade†	–0.1	–0.9	–0.1	0.3
Days absent‡	0.6	1.6	0.9	–0.1
Days tardy§	0.2	0.9	0.3	–0.4
Interview				
No. (%)	85 (100)	14 (17)	29 (34)	42 (49)
CDI total score‡	–0.2	4.6	0.6	–2.3
RCMAS total score§	–2.6	–2.3	–0.1	–4.4
PSC total score§	–2.6	–3.1	–0.8	–3.6
Teacher reported				
No. (%)	76 (100)	33 (43)	22 (29)	21 (28)
CTRS-39 score‡	–4.5	2.6	–6.0	–8.3

**Grades are expressed on a 4.0 scale (A = 4.0). CDI indicates Child Depression Inventory[30]; RCMAS, Revised Children's Manifest Anxiety Scale[32]; PSC, Pediatric Symptom Checklist[34]; and CTRS-39, Connors' Teacher Rating Scale-39,[37] Hyperactivity Index (Baltimore, Md, sample only).*
†P<.001.
‡P<.01.
§P<.05.

days) than children who ate school breakfast sometimes (1.9 days) or often (1.5 days) during the last academic term ($z = 2.3$; $P = .02$). Children who ate school breakfast rarely were also tardy significantly more (1.2 days) than children who ate school breakfast sometimes (0.1 days) or often (0.4 days) ($z = 2.9$; $P = .003$).

Interview Measures

After 4 months of the UF breakfast program, children who ate school breakfast rarely had somewhat worse mean CDI and PSC scores than children who ate often, although these differences failed to reach statistical significance (Table 3) ($z = 2.5$; $P = .20$ and $z = 0.8$; $P = .40$, respectively).

Hyperactivity

At the time of the reassessments, the mean CTRS-39 Hyperactivity Index score for the children classified as eating school breakfast rarely (58.3) was significantly higher than it was for the children who ate school breakfast sometimes (53.4) or those who ate school breakfast often (47.3) ($z = 2.9$; $P = .003$).

CHANGE IN PARTICIPATION IN BREAKFAST PROGRAM

School-Recorded Measures

Table 4 shows the relationship between *changes* in school breakfast participation and *changes* in child academic and psychosocial adjustment scores. In the reinterview sample, 56 (42%) of the 133 students increased their school breakfast participation rate, 49 (37%) had the same school breakfast participation rate, and 28 (21%) decreased their school breakfast participation rate. Although these changes in breakfast participation groups in the interview sample did not reach statistical significance, as reported previously, the overall mean school breakfast participation in the 3 schools increased from 15% before to 27% after the UF breakfast program and was statistically significant. Hungry or at-risk children were somewhat more likely to increase their school breakfast participation than nonhungry children (20 [46%] vs 36 [40%]), although this difference was not statistically significant ($z = 0.8$; $P = .40$).

Math Grades. Children who increased their rate of school breakfast participation were significantly more likely to increase their math grades (+0.3 of a grade) than children who had the same or decreased school breakfast participation (–0.1 and –0.9 of a grade, respectively) ($z = 4.2$; $P < .001$).

Absence and Tardy Rates. Children who increased their rate of school breakfast participation decreased their rate of school absence (–0.1 days) compared with increases of 0.9 days and 1.6 days for students whose breakfast participation rates stayed the same or decreased ($z = 2.6$; $P = .009$). Children who increased their school breakfast participation were also late to school significantly fewer days (–0.4) than children whose school breakfast participation remained the same (+0.3 days tardy) or decreased (+0.9 days tardy); a change that was also statistically significant ($z = 2.5$; $P = .01$).

Interview Measures

The mean total CDI score decreased by 2.3 points for children who increased their school breakfast participation

compared with an increase of 0.6 points for children whose school breakfast participation stayed the same and an increase of 4.6 points on the CDI for children who decreased their school breakfast participation ($z = 2.9$; $P = .004$). Children who increased their breakfast participation had significantly greater decreases in total RCMAS score (–4.4 points) compared with children who had the same or decreased school breakfast participation (–0.1 or –2.3 points on the RCMAS, respectively) ($z = 2.0$; $P < .05$). Finally, children who increased their breakfast participation rates had the largest decrease in total PSC score (–3.6 points) compared with children with the same or decreased (–0.8 and –.3.1 points, respectively) breakfast participation, although this difference failed to reach statistical significance ($z = 0.8$; $P = .40$).

Hyperactivity

Students who increased their breakfast participation had significantly greater decreases in their total CTRS-39 Hyperactivity Index scores (–8.3 points) than children who had the same school breakfast participation (–6.0 points) or children who decreased their school breakfast participation rate (+2.6 points) ($z = 2.7$; $P < .01$).

COMMENT

In this study of school breakfast participation in 3 inner-city public schools, fewer than 1 in 5 elementary and middle school children were eating school breakfast prior to the start of a UF school breakfast program, confirming previous reports that the National School Breakfast Program is vastly underused in terms of the numbers of children served and, possibly, its potential to correct some of the negative effects of chronic undernutrition among low-income children in this country. Following the implementation of a UF breakfast program, the present study documented a nearly 100% increase in school breakfast participation and significant gains in academic and emotional functioning for the children whose breakfast participation increased.

Before the UF breakfast program, cross-sectional analyses showed that higher levels of school breakfast participation were associated with better performance on a variety of measures of academic and psychosocial functioning in children. Children who ate school breakfast often had significantly higher math grades and significantly lower symptom scores on child-, parent-, and teacher-reported questionnaires than children who ate school breakfast sometimes or rarely. In the longitudinal follow-up analyses, students who increased their school breakfast participation showed the greatest academic improvements in their math grades, attendance, and punctuality. These children also demonstrated the greatest improvements in functioning on standardized measures of depression and anxiety as reported by students and hyperactivity as reported by teachers.

There are a number of limitations in interpreting these findings. First, causal inferences cannot be made since this was not a randomized, controlled study. However, a randomized study, which would ultimately cause some children who were eating breakfast to be deprived of breakfast, is impossible for ethical reasons. Second, the sample size was relatively small and thus susceptible to variations due to chance. Third, the sample may not have been representative because of loss of subjects at various stages in the sampling. Finally, the children we studied were predominantly African American students from inner-city public school districts, and the impact of school breakfast participation may differ in other racial or ethnic groups from various income levels in other locations.

It is possible that the improved psychosocial and academic functioning of the students may be due as much, or more, to an intervening variable as to the increase in the quality or quantity of nutrition per se. For example, it is possible that the observed changes may have been due to factors like the pleasure of increased socialization with peers rather than the improvement in nutrition. Even more plausibly, since in the present sample increased participation in school breakfast is associated with decreased school absence and tardiness, it is possible that improved math grades or decreased depression may be as much a function of increased instructional time as of better nutrition. Although the present sample was too small to permit meaningful analyses, a multiple regression model suggested that both variables (breakfast participation and attendance) were independently associated with improvements in student functioning. In any case, for the purposes of educational reform, this may be an irrelevant distinction since most educators would probably not care whether the improvements in academic performance and behavior were due to the increase in participation in the school breakfast program directly or indirectly through its capacity to increase attendance.

It is also possible that another intervention occurring at the same time may have been responsible for some or all of the observed changes. The research team was not aware of any special programs operating in the schools and such a situation is less likely given that the improvements occurred in 3 different schools in 2 different districts. Some students may have been in individual interventions like special education or counseling and these interventions, rather than the school breakfast program, may have led to the changes. Although the present study collected these data on only a subsample of subjects (the Philadelphia students), the relationship of these other interventions to increases in school breakfast participation appeared to be in the opposite direction, with students in counseling or special education less likely (but not significantly) to increase their school breakfast participation.

Having noted these potentially confounding factors, the fact remains that these findings are congruent with previous reports of the positive association between school breakfast participation and academic performance.[27,28] Significant decreases in child absenteeism and tardiness and increases in academic performance were observed in this study as they had been in the study by Meyers et al[28] conducted nearly a decade ago and the more recent report by Cook et al.[27] The students in these earlier reports were from different racial or ethnic groups and geographic locations than the students from the pres-

ent study. Thus, the association between increases in school breakfast participation and improved school attendance and punctuality has now been replicated across a range of ethnic groups and locations.

We have extended the observations made in these earlier studies by documenting for the first time, on an individual basis, a significant relationship between increases in school breakfast participation and decreases in psychosocial symptoms on standardized measures. The decreases found in the reports of children and teachers of psychosocial symptoms in relation to increased school breakfast participation are consistent with and of comparable magnitude to the increases in academic performance. It remains to be seen if the significant changes in academic, behavioral, and emotional functioning will be sustained for periods longer than the 4 months (1 school term) that the program was in place in our 3 study sites.

The associations between school breakfast participation and student functioning appeared to be meaningful as well as statistically significant. For example, in cross-sectional data, the students who ate school breakfast often had math grades that averaged almost a whole letter grade higher than the grades of the students who ate school breakfast rarely (B [3.0] vs C [2.1], respectively), a difference that most educators would probably find meaningful. In the longitudinal analyses, the observed change was of about the same magnitude (an increase of one third of a letter grade for students who showed an increase vs 1 full-grade decrease for those who decreased their school breakfast participation).

Similar associations were observed for the symptom measures reported by children, parents, and teachers. In the cross-sectional data, the symptom scores of students who ate school breakfast rarely ranged from 20% (CTRS-39 Hyperactivity Index) to 100% (CDI) higher than the scores of children who ate school breakfast often. Differences of this magnitude in psychological measures are generally considered clinically meaningful. In longitudinal data, the differences between students who increased and those who decreased their school breakfast participation were generally smaller, with decreases in mean scores of about 10% to 50%. Most teachers would probably notice such differences, at least regarding behavior in class. The fact that school breakfast participation was related to parents' reports on the PSC of total numbers of behavioral and emotional problems as well as to students' reports of anxiety (RCMAS) and depression (CDI) and teachers' reports of hyperactivity is in keeping with a recent report,[19] which showed that children's hunger was associated with a general increase of all types of behavioral and emotional symptoms.

The present study shows that it is possible to dramatically increase school breakfast participation by making it free to all children. According to 2 studies, it is actually possible to raise school breakfast participation rates to more than 80% (Abell Foundation, unpublished data, 1998; K. L. Wahlstrom, PhD, J. Schneider, S. Horn, M. Reicks, PhD, RD, and J. Labiner, unpublished data, 1996). Additional research already in progress is designed to assess the nutritional content of what students report eating both before and after expansions of school breakfast participation. Physical indicators of nutritional status, such as height, weight, and skinfold thickness, are also being studied in an attempt to tease apart the nutritional vs the social and psychological contribution of school breakfast. For now, however, the present study provides enough data on the positive changes that are associated with major increases in school breakfast participation to suggest that school districts would be wise to study school breakfast expansion as one possible avenue for improving student outcomes.

Our study demonstrates not only that substantial increases in school breakfast participation are possible through a universal feeding program, but also that a UF breakfast program can be implemented at little or no cost to the school district for schools with 70% or more of the students eligible for free or reduced-price meals. In these schools, the cost of a UF breakfast program is either free (under Provision 2 billing) or so low (using free, reduced, or paid billing) that local foundations, fundraising efforts, or the school district itself could cover the federally unreimbursed costs that turn out to be relatively low ($2000-$10 000 per year per school). From a public health as well as an educational point of view, the potential impact of increasing school breakfast participation through a UF breakfast program deserves much greater attention.

Accepted for publication April 6, 1998.

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This study was made possible through grants from the Kellogg Corporation, Battle Creek, Mich, and the Mid-Atlantic Milk Marketing Association, Towson, Md. In the Baltimore, Md, schools, the Abell Foundation, Baltimore, paid for the federally unreimbursed cost of making breakfast free to all students.

The generous cooperation of the Maryland Food Committee, Baltimore, and the participating teachers, students, and parents at the Edmonds, Lakeland, and Barrister Charles Carrol schools are gratefully acknowledged. Tom McGlinchy, Chuck Damianni, and Leonard Smackum, MBA, were instrumental in setting up the study and were major collaborators in this project.

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