

Educational Benefits of the United States School Feeding Program: A Critical Review of the Literature

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Abstract: In the Child Nutrition Act of 1966 it was stated that educational progress was an objective of the United States School Feeding programs. In spite of this fact no serious attempt has ever been made to evaluate whether this objective has been met; the few evaluations that have been conducted lack scientific rigor. As a whole the studies fail to provide a strong basis from which to make valid inferences regarding

the long-term effects of the feeding program on school achievement and adaptation. Studies that have focused on the short-term effects of hunger or morning feeding suggest that the provision of breakfast may both benefit the student emotionally and enhance his capacity to work on school type tasks. (*Am. J. Public Health* 68:477-481, 1978)

The involvement of the United States federal government in feeding children in schools may be traced back to the Agricultural Adjustment Act (P.L. 74-310) of 1935. Under this provision, the government distributed surplus meat, dairy products, and wheat to needy families and schools. It was in 1946, however, with the promulgation of the National School Lunch Program (P.L. 79-396), that the government decided to institutionalize feeding supplementation within schools throughout the United States.

Later, the Child Nutrition Act (CNA) of 1966 (P.L. 80-642) was passed in order to assume control over Breakfast and Special Milk Programs, Summer and Childcare Programs, and Maternal and Infant Feeding Programs. The objectives of this Act, as stated in Section 2, are as follows:

“In recognition of the demonstrated relationship between food and good nutrition and the capacity of children to develop and learn, based on the years of cumulative successful experience under the national school lunch program with its significant contributions in the field of applied nutrition research, it is hereby declared to be the policy of Congress that these efforts shall be extended, expanded, and strengthened under the authority of the Secretary of Agriculture as a measure to safeguard the health and well-being of the Nation’s children and to encourage the domestic consumption of agricultural and other foods, by assisting States, through grants-in-aid and other means, to meet more effectively the nutritional needs of our children.”

(P.L. 89-642, 11 October 1966, 80 Stat. 885-890.)

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This review attempts to determine whether educational progress as an objective of the U.S. School Feeding Program has, in fact, been met. This paper presents a selective review of the literature bearing on how the behavior of students in a school setting is affected by short-term hunger, or by school feeding programs. The inclusiveness of the review attempts to compensate for the relative lack of evaluative data on the specific behavioral effects of the school lunch and breakfast programs. Looking at studies related to, but not directly focusing on, the issue at hand may prove useful in understanding the effects of such programs.

Broadening the limits of the review, however, does not increase the number of scientifically sound studies. It is important to note at the outset that this area of research is characterized by an absence of specific hypotheses, ambiguity in the definition of variables, a lack of data on the validity and reliability of the measures used, and a lack of consideration of relevant moderating variables. These methodological weaknesses are the strongest evidence for the need for evaluative research.

M. S. Read published a review in 1973, entitled “Malnutrition, Hunger and Behavior”,¹ a first attempt at forcing some order into the few available studies. In contrast to Read’s work, this study focuses on investigations conducted in the United States or other developed countries and makes no attempt to relate the data obtained within school settings to the literature on protein-calorie malnutrition and behavior in developing countries.

The studies are subdivided into two basic categories: short-term behavioral effects of morning feedings and hunger, and long-term effects (e.g., on school performance) of school feeding programs. Before beginning the review, it is

necessary to define the term hunger as it is used in this report. Currently, there is no universally accepted definition of hunger because of its multifactorial complexity, which includes not only metabolic and neurophysiologic factors but also an emotional component. Moreover, the manifestations of hunger are likely to interact with the nutritional history and status of the individual as well as with the frequency with which it has been experienced. As such, it has been extremely difficult to quantify hunger, or even to claim that it is a uniform psychobiological phenomenon across the human species.

For our purposes, it is not necessary to define the biological dimensions of hunger. None of the studies reviewed touch on such issues. It is important to note, however, that whatever the effects of hunger on the behavior of school children may be, they are surely not mediated by changes in neural structure. Any behavioral effects are likely to be associated with short-term metabolic and neurohumoral changes.

Short-term Behavioral Effects of Morning Feeding and Hunger

In this section, the studies focusing on the short-term behavioral effects of taking or not taking breakfast or of having a mid-morning snack are reviewed. The section also includes research on the effects of the same hunger-satiety variables on physical activity measures, e.g., endurance. These data give some insight into the effects in the school setting of not eating breakfast.

In 1931, Laird, Levitan, and Wilson² postulated that hunger pangs and nervousness in children were related. To test this hypothesis, 48 children from grades 1, 3, and 5 were studied for two weeks. Nervous children, selected on the basis of a behavior checklist completed by the teacher, were divided into three groups: those receiving no special feeding (control group, played with toys), those receiving milk, and those receiving milk plus a calcium supplement. The feeding was administered at 9:30 am, and teachers were unaware of the experimental groupings. It was stated that a 6 percent mean reduction in nervousness occurred with milk feeding over a two-week period. The teachers reported improvements in behavior, such as, "less abstracted and more wide awake, more careful and less slovenly in thinking, and less easily fatigued." Nevertheless, 50 percent of the milk-fed group showed no improvement or were worse at the end of the two-week period.

Laird, et al.,² concluded that nervousness in elementary school children is related to hunger, and that mid-morning feedings of milk reduced nervousness. They also concluded that milk plus a calcium supplement decreased nervousness further, although no indication of baseline calcium nutriture was mentioned.

Criticism of this study is difficult because the reported results make little use of any statistical analysis. Furthermore, the idiosyncrasies of the behavioral terminology do not fit any theoretical framework and suggest the difficulties the authors must have had in explaining their own data. This problem is well exemplified by the categories of behaviors,

e.g., "repulsive bearing and physique," "mentally lethargic," or "average qualities of masculineness."

Keister³ studied the effects of a mid-morning administration of fruit juice on hyperactivity, withdrawal, hostile behavior, and nervous habits of 133 children 27-60 months of age attending a nursery school. Each child was studied four times during the year—twice when receiving fruit juice and twice when receiving water. The behaviors were assessed by observation of each child for a 30-second interval after the 10:00 am feeding of fruit juice or water.

The results indicate that the target behaviors appeared less frequently among children receiving fruit juice than among those receiving water. There were no significant age differences. Males, however, showed a greater reduction in the incidence of "negative" behaviors with administration of fruit juice than females.

Matheson⁴ assessed the value of a mid-morning orange juice feeding for 100 fifth grade students from three different schools. The study was conducted over a 10-day period, and performance on arithmetic (addition) and letter symbol decoding tests was the outcome variable studied. Because the children acted as their own controls, they were exposed to an experimental and a control situation on different days. The 10:30am orange juice supplementation was associated with significantly better performance at 9:15, 10:30, and 11:45am on tasks of decoding and addition. Tests taken after the orange juice feeding at 10:30 showed the most significant differences with respect to decoding tasks.

Matheson⁴ found that the time at which the arithmetic or decoding task was given (e.g., 9:15, 10:30, 11:45am) did not significantly affect the performance of children whose usual breakfast intake was poor or good (mid-morning orange juice feeding was not involved in these comparisons). However, he did not obtain breakfast intake data on the day of testing; the quality of usual breakfast intake was determined by a three-day written food record collected several weeks after the experiment had been conducted.

Dwyer, Elias, and Warren⁵ studied the effects of an instant breakfast (liquid meal) on 139 males in the first grade. The children were tested individually on tasks of attention (slow tapping test, digit test, block test) and for short periods on eye gaze (to assess attention maintenance within the classroom). One-half of the pupils were fed the breakfast in the morning and one-half in the afternoon. The investigators found no between-group differences in performance on any of the tasks of attention measured between 9:30am and noon. Although home breakfast intake among the control group was obtained by dietary recall on the day of testing, results were reported in terms of "sporadic" breakfast eaters and "always eats breakfast" rather than in terms of intake of particular nutrients (e.g., calories) on the day of testing.

A series of studies has been conducted to assess the effects of different breakfast conditions on physical performance in children. In one study, by Tuttle et al.,⁶ 12- to 14-year-old boys alternated between periods of eating cereal and milk for breakfast and no breakfast for 17 weeks. The boys' total daily nutrient intake was kept constant. Six categories of physiologic responses were tested in the late morn-

ing, and the results indicated that the omission of breakfast had no effect on neuromuscular tremor magnitude, choice reaction time, maximum grip strength, or grip strength endurance. Nevertheless, by both individual and group means, maximum work rate and maximum work output, as measured by a bicycle ergometer, were lower when breakfast was omitted.

These same investigators⁶ designed other experiments to determine the relationship between physiologic responses and a variety of breakfast types. Twenty-five boys were involved in these tests. The authors concluded that there was no significant difference in physiologic response in the late morning between subjects consuming cereal and milk and those consuming bacon and eggs for breakfast.

Arvedson and associates⁷ reported that, in the early 1950s, it was believed that breakfast should provide one-quarter of the total daily protein and energy intake to ensure maximum physical and mental efficiency in the late morning hours. To test this assumption, Arvedson and her colleagues studied 203 children, ages 7-17 years, from various Stockholm schools. They found that, in relation to age-group allowances for daily intake, only one-third of these children consumed a breakfast containing 25 percent of their daily protein and caloric allowances. To determine whether this low intake had any effects on physical capacity, the investigators studied 40 boys, ages 11-17 years. The students were divided into two groups of similar size, age means, and ranges. Four breakfasts were designed and exchanged on an isocaloric basis during the four weeks of the experiment. (There were two high-carbohydrate breakfasts, one 400 calories and the other 560 calories [60 percent carbohydrate] and two high-protein breakfasts, one 400 calories and the other 560 calories [35 percent protein].)

Work tests involving a bicycle ergometer were given 3-3 ½ hours after breakfast and immediately after a finger-prick test for blood glucose. The authors were unable to find differences in physical capacity according to the type of breakfast eaten, although blood glucose was significantly higher after a high-protein breakfast (88 mg/100 ml) than after a high-carbohydrate breakfast (79 mg/100 ml), as determined by a t-test ($P < 0.001$). Blood glucose for the no-breakfast condition was 84 mg/100 ml.

In conclusion, the review of studies on the short-term effects of hunger and feeding does not yield a uniform set of data. Two researchers examined emotional dimensions of behavior, two others focused on cognitive components, and the remaining two concentrated on measures of physical activity. The studies on emotionality suggest (with some consistency in the data) that, at least among preschoolers and children up to the fifth grade, a morning snack or juice may be beneficial—in very general terms—to the recipients. However, it is not possible to specify from the data what these benefits really are. The researchers use vague terms, such as “nervousness” or “hyperactivity,” and do not provide clear operational definitions of such variables. Thus, no conclusive inferences can be drawn.

In connection with the studies on the cognitive components of behavior, there is some discrepancy between the data of Dwyer, et al.,⁵ and those of Matheson.⁴ The former

found that breakfast had no detectable effect on attention, whereas the latter observed beneficial effects on an arithmetic and a decoding task. Matheson concluded that “students score higher on school type tasks undertaken shortly after food is given than when no food is given”⁴ (p. 45).

It is not clear why these two studies yielded contradictory results. One possibility is that they may have tapped different mental abilities with different sensitivities to the nutrition variable. It is also conceivable that the home intake differed between the populations used in the two studies. However, such possibilities must remain at the hypothetical level, since the available data are insufficient to clarify the issue. What can be said is that Matheson's study,⁴ which is one of the best in the group, supports the contention that morning food supplementation in school brings about some beneficial effects on the children's performance in school-type tests.

In connection with the measures of physical activity, there again seems to be a contradiction between the two studies reviewed. It must be noted, however, that one evaluation⁶ involved a breakfast-no breakfast condition, whereas the other study⁷ compared the effects of various breakfasts having different caloric, carbohydrate, and protein levels. From all the data obtained, perhaps the most meaningful finding in terms of our present concerns is that the omission of breakfast interfered with the children's maximum work rate and output.

All told, the data give some indications that short-term hunger (due to lack of breakfast) may have some adverse effects on emotional behavior, arithmetic and reading ability, and physical work output as measured by an ergometer.

School Lunch and Breakfast and Behavior

In this section, the few reports that present data from evaluations of the long-term behavioral effects of school feeding programs are reviewed. The investigations included in this section looked for effects over months or years. In contrast to the short-term effects reviewed previously, these long-term effects are more meaningful in terms of educational progress or successful adaptation to the school setting and are likely to be enduring.

Lininger⁸ studied the effects of a school milk program on scholastic progress over a two-year period among 4,133 “undernourished” school students ages 6 to 16 years. The children were enrolled in special health classes in which milk drinking was one of many practices used to improve their health. The index of scholastic progress was obtained from teachers' subjective comments. Over the period of the study, 45 per cent of the children receiving milk improved in “scholarship,” whereas only 24 per cent of those not receiving milk improved. The teachers, however, presumably knew which children were and which were not receiving milk. Thus, for obvious reasons, it is impossible to determine whether the effects reported were caused by the milk supplement or by the teacher's expectations.

In a year-long study, Kreitzman⁹ looked at attendance plus school grades in order to determine the effects of break-

fast programs. His investigation involved third and fifth grade children from two schools in Atlanta, Georgia, who lived in a government housing project. One school began its breakfast program in January, and the other had no breakfast program. At the end of the school year, there was no difference between the two third grades in achievement test scores. This finding, however, may have been related to a supplementary educational program that was operating for the third graders in the control school. The fifth graders in the experimental school did as well or better on every segment of the achievement test than the control group. Kreitzman's report of the evaluation he conducted is better described as a journalistic effort than as a scientific paper. He gives a cursory description of the methods used, does not report any statistical treatment of the data collected, and fails to discuss apparent discrepancies in his results as presented in a graph. It is unfortunate that we have to use this type of material in order to make inferences about the possible effects of the feeding program.

Lieberman, et al.,¹⁰ studied the effects of a breakfast program among low-income black ghetto children in grades 3-6 over a school year. A breakfast-program school (N = 281) was compared with an adjacent, non-breakfast-program school (N = 300). Five psychological tests were administered that reportedly measured ability to concentrate, remember, think abstractly, and work in a classroom. The authors concluded that the school breakfast program had no long-term effect on performance on psychological tests. It is noted, however, that the children in both groups were originally well nourished (reported by dietary evaluation, physical examination, and anthropometric evaluation). Therefore, the assumption that malnutrition (defined by the stated parameters) and low-socioeconomic status go hand in hand was not upheld. Given the fact that the children were originally well nourished, one would not expect a breakfast program to enhance tests based on the assumption that nutritional status would be improving. Furthermore, 52 per cent of the children participated in less than 35-54 per cent of the breakfasts.

Fellers¹¹ studied the effects of a breakfast program on 198 tenth grade students on school grades and drop-out rate over a school year. School grades were used as an index of achievement. The results showed that participants and non-participants had similar final grades and similar drop-out rates. However, as with the Lieberman paper,¹⁰ the degree of participation was less than maximal, and Fellers failed to consider participation as a moderating variable.

Tisdall, et al.,¹² evaluated over 200 school lunch participants and non-participant controls, ages 5 ½ to 10 years, over a three-year period. Indices of school achievement utilized were: school marks as recorded by teachers, scores on intelligence tests, and scores on objective tests of reading and arithmetic. Participants and non-participant controls were reportedly matched exactly for sex, school grade, and by a medical examination and "as closely as possible" for classroom, age, height, weight, economic status, dental conditions, mental ability, and school achievement.

The authors concluded that there was no evidence to indicate the school lunch program accelerated mental or edu-

cational development. However, statistical analyses were not presented in the report, thus making any critique of the conclusions difficult. It is also not quite clear whether the authors controlled for degree of student participation in the school lunch program with respect to the school achievement comparisons. The combined impact of the breakfast and lunch programs was not studied.

Pinkus¹³ compared breakfast habits, school performance, and hunger-related behaviors between fourth grade children participating in the National Breakfast Program and children of the same grade attending non-participating schools. The eight schools involved were matched for size of fourth grade, predominant race, and number of teachers in grades 1-6. All schools were located in Louisiana and met the government criteria for participation in the National Breakfast Program. Attendance records from March to September were used in the study. In March, data collection involved the responses of teachers, parents, and nearly 200 pupils to questionnaires concerning many aspects of breakfast and breakfast programs. The investigators found that breakfast was skipped by nearly one-quarter of the pupils in the schools with no Breakfast Program, and by less than a tenth of the children in participating schools. More students from schools with a Breakfast Program ate a basic breakfast than the others. Educational level of the mother was not found to be related to the children's eating habits.

All pupils recorded the number of times in the past month they had experienced nausea, headaches, stomachaches, and coughs. There was a significant difference between experimental and control subjects in the reports of nausea ($P < 0.05$), stomachaches ($P < 0.01$), and coughs ($P < 0.01$). The students also reported the number of times during the month they cried, were angry, had been asked to pay attention or to stop misbehaving. Parents and teachers recorded incidences of the same behaviors for one week. Although no significant differences between the groups of children were noted by their parents or teachers, a higher proportion of the pupils in non-participating schools reported having all problems more frequently (e.g., misbehaving was reported twice as frequently in non-participating schools). Neither absenteeism nor scholastic achievement, as determined by the number of D's and F's recorded for one month, were significantly different. However, the paper did not indicate whether or not teachers in all schools graded on a curve. If this were the case, no differences in grades between the classes should have been expected.

Koonce¹⁴ conducted a study in Anchorage, Alaska, to determine whether any differences existed between children who received both breakfast and lunch at school and those who received lunch only. The students were in the first through third grades. Those serving as controls received only lunch. Attendance was scored for each child by subtracting the number of absences in September to December 1970, from the number in September to December 1969, the year before the program was initiated. No significant difference was found in attendance. The author suggested that perhaps the three-month period was inadequate for comparative purposes.

Increases in weight and height were calculated over the

period from September to December 1970. A trend indicated greater weight gain in the breakfast and lunch group, but it was not significant.

This experiment also included a well-organized study of classroom activity. Teachers rated each student on "general disposition." Rating sheets were collected in September and December. The paper made no statement concerning the teachers' knowledge of the pupils' meal status. The author concluded that the children who received both breakfast and lunch obtained higher ratings in all areas assessed than the children receiving only lunch. The score differentials were statistically significant, suggesting a better school "disposition" on the part of the experimental group.

In summary, like the studies of short-term effects of morning hunger and feeding, the work reviewed on the long-term effects of school feeding do not yield a uniform set of data. In the long-term studies, however, the investigators had similar notions of what behavioral variables to study. Most of them focused on school grades, achievement, and attendance.

The data show that, while two investigators^{8,9} found a beneficial effect of school breakfast on school performance, the other five investigators¹⁰⁻¹⁴ failed to detect such differences. It is impossible, however, to identify the reasons behind such contradictory findings because most of these reports present only brief descriptions of their samples and methods. Nonetheless, some of the data suggest that there are many important moderating variables (e.g., degree of participation in the feeding programs, teachers' expectations of success, food intake on the day achievement tests are administered) that must be measured and controlled in order to have a valid assessment of the nature of the correlation between feeding and achievement. The differences in the designs and the samples of the various studies may also account for some of the different results obtained.

The study by Lieberman, et al.,¹⁰ illustrates how the nature of the sample may determine the nature of the results. In that study, there was no detectable difference between the experimental and control subjects in a series of school-performance-related measures. However, the recipients of the program were well nourished before the initiation of the treatment, and, therefore, the food program may not have brought additional nutritional benefit. If that were the case, it is not surprising that the nutritional input brought no additional educational benefit. An important question that remains unanswered is whether a program that starts with poorly nourished recipients and brings about nutritional improvements would fail to benefit the educational status of the children.

As a whole, the studies fail to provide a strong basis from which to make valid inferences regarding the long-term effects of the feeding programs on the school achievement

and adaptation of the children. It is immediately apparent that the studies have failed to monitor closely many important moderating variables and that their methods were not sound. Conversely, the studies that focused on the short-term effects of hunger or morning feeding suggest that the provision of breakfast may both benefit the student emotionally and enhance his/her capacity to work on school-type tasks.

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