THE NUTRITIONAL IMPACT OF BREAKFAST CONSUMPTION ON THE DIETS OF INNER-CITY AFRICAN-AMERICAN ELEMENTARY SCHOOL CHILDREN

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To determine the contribution of breakfast-eating behavior to dietary adequacy among low-income African-American children, 1151 children attending grades two through five at four elementary schools in East Orange, New Jersey were studied. Results of a 4-day eating behavior survey and a 24-hour dietary recall reveal that on any given day, 12% to 26% of children attend school without having eaten anything. Thirty-six percent of the children were obese, which did not vary with breakfast-eating behavior. A significantly greater proportion of the children who skipped breakfast compared to those who ate breakfast failed to achieve dietary adequacy for nearly every nutrient studied. More than one third of breakfast skippers consumed <50% of the recommended dietary allowance for vitamins A, E, B_6, and folacin, and nearly one fourth consumed <50% of the recommended dietary allowance for calories, vitamin C, calcium, and iron. Not eating breakfast results in substantial deficits in dietary intake of a variety of essential nutrients among low-income African-American school children. Efforts to improve the nutritional status of children should include nutrition education to promote breakfast. (*J Natl Med Assoc.* 1995;87:195-202.)

Key words • breakfast • dietary intake • school children • African-American children

Although clinically apparent micronutrient deficiency and protein-energy undernutrition are uncommon in the United States, substantial segments of the population may be at risk for mild or subclinical micronutrient and macronutrient deficiencies due to inadequate diets. Dietary adequacy is particularly important for children with their proportionately greater nutrient requirements to sustain normal growth and development. Mild nutrient deficiencies can result in long-term adverse effects on growth and function.[1]

More low-income children in the United States are deficient in a number of essential nutrients than their more fortunate peers,[2] and as a result, growth deficit and iron deficiency are more prevalent among poor children[3,4] despite several food supplement programs offered by the US government, including the Food Stamp Program, Special Supplemental Food Program for Women, Infants, and Children (WIC), the National School Lunch Program (NSLP), and the School Breakfast Program (SBP).

The food choices made by a child and his or her family, including the decision to have or to skip a meal, undoubtedly affect the probability that the child will consume a nutritionally adequate daily diet. Given the 80% participation of low-income school children in the NSLP,[5] which is mandated to

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provide one third of recommended dietary allowances for essential nutrients,[6] decisions regarding breakfast and dinner are of increased importance on school days. Morning cognitive function in school children may be improved following breakfast compared with function in the fasting state,[7,8] and children who skip breakfast may not regain the lost nutrition provided by breakfast during the remainder of the day.[9] Therefore, the morning eating behaviors of low-income children and their dietary impact were assessed by examining baseline data collected during a study of a newly implemented School Breakfast Program (SBP) in East Orange, New Jersey,[10] prior to SBP implementation.

METHODS

Study Site and Population

East Orange, New Jersey, is a dense urban area with a population of 77 525, of which 88% are black, 9.8% white, and 3.3% Hispanic. The average household income is $16 468 and mean per capita annual income is $6286. The median years of education completed by the adult population is 12.4, with 34% completing <11 years and 11% >16 years. Thirty-seven percent of mothers are single.[11]

There are nine elementary schools in East Orange, with approximately 8000 students in grades kindergarten through eight. Total enrollment for children in the study grades two through five is approximately 4000. The East Orange School District chose four elementary schools to be included in this study based on their knowledge of the student population. Selection criteria for the study schools included their having similar proportions of low-income children ("severe need status"), having similar numbers of total students in the study grades, and being located in comparable neighborhoods with demographically similar student bodies. Seventy-nine percent of all children in the elementary grades of the study schools qualified for free (70%) or reduced-price school meals. All children in regular classrooms (excluding special education, emotionally disturbed, neurologically disabled, and bilingual) in grades two through 5 in these four schools were eligible for study if they had complete dietary recall data. All children included in the study were fluent English speakers. Parental consent forms were sent home with all children in the study classrooms, and children whose parent(s) declined consent were not included in this study.

Breakfast-Eating Behavior Survey

In September 1989, a self-administered eating-behavior survey was distributed to all study children on 4 random days over a 2-week period. The survey form contained four sections (one for each day) and was handed out and collected by the homeroom teachers at the start of the school day. Children were asked to fill out the forms with pen to decrease the possibility of changing answers from a previous survey day. The survey asked the following two questions: Did you have anything to eat before coming to school? Did you eat a snack on the way to school?

24-Hour Dietary Recall

Twenty-four hour dietary recalls were obtained from all study children in October 1989. Women from East Orange and nearby communities were hired and trained in dietary recall methods, including the use of models and measuring tools. Interobserver reliability was ensured by having all interviewers collect recall data from one of the investigators (A.E.S.), who acted as a test subject; with practice, a high degree of accuracy was demonstrated. All interviews were monitored by an investigator (A.E.S.).

Children were asked to begin with the morning of the recall and report all foods consumed up to the time of the interview (which followed the lunch period), they then were asked to recall all foods or beverages consumed from the time they left school on the previous day until they went to sleep. The recall period did not include the hours spent in school between lunch and the time the children left school on the day prior to the interview because consumption of food and beverages is not allowed during these hours. Teachers of the study classrooms reported no parties, special events, or observed consumption of food or beverages on days included in the dietary recalls.

Children were considered to have eaten a morning "snack" if they used that term when asked what they had eaten on the day of recall between awakening and lunchtime, or if they reported eating anything on the way to school. All questions were interviewer-administered and none required reading by the child. Only children who were not ill on the days of or prior to the recall were included in the dietary analysis. Added salt and dietary vitamin-mineral supplement use was not assessed. All recall data were reviewed for consistency, and marked variability was not noted; data also were reviewed immediately for comparability with school lunch content, and where variation was noted, the source of the difference was identified.

Trained graduate student research assistants entered the dietary recall data into the Nutriquest II microcomputer-based nutrient analysis system.[12] Certain foods

that were consumed by the study population were not included in the Nutriquest database, which was updated to include all such foods, and to correct values for foods that may have changed since the database was formulated, using information that was provided by the food manufacturer or the US Department of Agriculture handbook number 456.[13] Analysis of a test meal using this program gave results comparable to that of the Tufts Nutrient Database.[14] Nutrients were selected for study based on their importance to health and the availability of reliable dietary content data.

Study Design and Statistical Methods

The height and weight of the study children as recorded by school nurses were compared with the National Center for Health Statistics (NCHS) standards using the anthropometric program contained in the Centers for Disease Control and Prevention's EpiInfo Version 5 software.[15] Nutrient adequacy was calculated using sex- and age-specific standards found in the 10th edition of the *Recommended Dietary Allowances* (RDAs).[16] The following nutrients were examined: calories (kcal), protein (g), fat (g), and % calories from fat and cholesterol (mg); vitamins A (IU), D (mcg), E (mg, alpha TE), C (mg), B_6 (mg), B_{12} (μg), thiamin (mg), riboflavin (mg), niacin (mg), and folacin (μg); and calcium (mg), magnesium (mg), iron (mg), and sodium (mg).

Children were initially classified into one of the following four categories depending on their morning eating behavior as determined by the 24-hour dietary recall:

- breakfast eaters,
- breakfast-and-snack eaters,
- snack-only eaters, and
- neither-breakfast-nor-snack eaters.

Median test comparisons of breakfast eaters with breakfast-and-snack eaters showed that the two groups were comparable in nutrient intake at breakfast and for 24 hours; similarly, the snackers were comparable with the neither-breakfast-nor-snack eaters for 24 hour intake. Therefore, in comparative nutrient analysis by breakfast eating behavior, the breakfast-and-snack eaters were included in the "breakfast eaters" group, and snack-only eaters were included in the "breakfast skippers" group. Because the validity of 24-hour dietary recall has been questioned in younger children, the results for second-grade students and those in the higher grades were compared using nonparametric tests.

Nutrient adequacy was defined as ≥80% RDA and determined for each child using 24-hour dietary recall data. The proportions of children achieving dietary adequacy for each nutrient of interest within each breakfast eating behavior category were compared using chi-square statistic. In addition, to assess the prevalence of extremely low nutrient intakes, the proportion of children in the "breakfast eaters" and "breakfast skippers" groups consuming less than half the RDA for study nutrients were determined and compared with the chi-square statistic. The relative nutrient contribution toward daily intakes and the percentage RDAs provided by different types of morning meals were compared using nonparametric tests. The SPSS statistical package was used for statistical analysis.[17]

RESULTS

Demographic Characteristics

A total of 1401 children were eligible for the study; the parents of 161 (11.4%) declined consent, and two 24-hour dietary recalls were completed on 1151 children (82%), which comprised the study sample. One thousand one hundred nineteen (97%) were African American, 1125 (98%) spoke English as their first language, 585 (51%) were male, 237 (21%) were in grade two, and 914 (79%) were in grades three to five.

Morning Eating Behavior Survey

On each of the 4 survey days, between 964 and 998 children (84% to 87% of the study sample) responded to the survey. On any of the 4 days, 22% to 26% of children reported not eating before arriving at school. Of the 600 children who responded to the survey on all 4 days, 71% stated they ate before coming to school on all 4 survey days, 4% on none of the survey days, and 25% on 1 to 3 days.

24-Hour Dietary Recalls

Data were obtained for each of 1151 children in grades two through five attending the four study schools. On the day of the dietary recall, 905 (79%) of the study children reported eating only breakfast, 19 (1.3%) reported eating only a morning snack, and 94 (8.2%) reported eating both a breakfast and a snack. One hundred thirty-three (12%) reported eating nothing prior to school. Mean age of breakfast skippers was greater than that of breakfast eaters (9.8 years versus 9.3 years; $P = .005$), but gender did not differ significantly between the two groups.

The percentage RDA provided by breakfast did not differ for those children eating breakfast only compared

TABLE 1. PERCENTAGE OF CHILDREN WITH DAILY NUTRIENT INTAKES <80% AND <50% RECOMMENDED DIETARY ALLOWANCE (RDA) BY BREAKFAST-EATING BEHAVIOR

	% Consuming <80 RDA*			% Consuming <50 RDA†		
Nutrient	Sample (N=1151)	Eaters (n=999)	Skippers (n=152)	Sample (N=1151)	Eaters (n=999)	Skippers (n=152)
Calories	49.1	45.6	71.7	9.1	6.8	24.2
Protein	2.3	1.6	7.2	0.5	0.2	2.6
Vitamin A	56.2	53.2	76.3	29.3	25.5	54.2
Vitamin D	91.7	90.7	98.6	62.0	50.0	89.9
Vitamin E	47.5	45.3	62.2	29.2	27.0	44.3
Vitamin C	23.9	20.7	44.7	12.8	10.0	30.7
Vitamin B_{12}	4.4	3.9	7.3	1.5	1.3	2.6
Vitamin B_6	47.9	43.8	74.3	23.2	19.8	45.1
Thiamin	18.5	13.2	53.3	3.7	2.0	14.6
Riboflavin	8.3	5.4	23.2	2.0	1.3	6.5
Niacin	16.9	13.6	48.8	5.2	3.6	15.7
Folacin	22.5	15.9	65.8	11.0	6.2	42.5
Calcium	42.2	36.9	77.0	12.7	10.1	29.4
Magnesium	29.6	25.3	57.9	4.8	3.5	13.1
Iron	33.2	29.0	61.2	7.0	5.0	24.0

*Breakfast eaters had significantly greater intakes ($P<.05$ for all nutrients except B_{12} compared with breakfast skippers.
†Breakfast eaters had significantly greater intakes ($P<.05$) for all nutrients compared with breakfast skippers.

with those eating both breakfast and a morning snack; thus, eating a snack appeared not to affect the nutritional content of breakfast. Morning snack consumption contributed fat and calories to the diets of breakfast skippers and fat, iron, and thiamin to those of breakfast eaters. The additional iron and thiamin only served to increase already adequate intakes. Self-reports of intake at lunch were qualitatively highly consistent with the school lunch menu. Adequacy of intake of major nutrients (carbohydrate, protein, fat) was not significantly different between children in grade two and those in the higher grades; a significantly lower proportion of second graders had inadequate intake of folacin and calcium, while a greater proportion had inadequate intake of vitamin B_{12}.

Nutrient adequacy data by breakfast-eating behavior are presented in Table 1. Less than 10% of all children studied failed to achieve dietary adequacy for intake of protein and vitamin B_{12}, while more than 40% consumed inadequate amounts of calories, vitamins A, E, and B_6, and calcium, and more than 90% consumed inadequate vitamin D. Significantly more breakfast skippers consumed inadequate amounts of all nutrients studied except vitamin B_{12}. The proportion of children with intakes below 50% RDA by breakfast eating behavior for each nutrient is shown in Table 1. More than one third of breakfast skippers consumed <50% RDA for vitamins A, E, B_6, and folacin, and nearly one fourth consumed <50% RDA for calories, vitamin C, calcium, and iron.

Daily and breakfast intake data for cholesterol and sodium, and for the percent of calories from fat, are presented in Table 2, and the proportion of the groups consuming above the recommended daily amount of cholesterol (300 mg) and proportion of calories from fat (30%) are shown in Table 3. Breakfast skippers consumed significantly less daily sodium and cholesterol but a greater percentage of their daily calories from fat than did breakfast eaters; more breakfast skippers than breakfast eaters were below the recommended limit for daily cholesterol intake but above the recommended daily percentage of calories from fat.

Contribution of Breakfast to Daily Nutrient Intakes

Of the 999 breakfasts consumed by children on the day of the dietary recall, 57% included cereal (40% cold, 17% hot). Table 4 shows adequacy of daily nutrient intake by breakfast type. The proportion of children consuming adequate calories and protein did not differ between cold cereal, hot cereal, and noncereal breakfast eaters; however, substantially more children who ate either a hot or cold cereal breakfast achieved

TABLE 2. PERCENTAGE OF CALORIES FROM FAT, CHOLESTEROL, AND SODIUM BY BREAKFAST-EATING BEHAVIOR

Nutrient	Sample (N=1151) Median	Sample (N=1151) IQR	Breakfast Eaters (n=999) Median	Breakfast Eaters (n=999) IQR	Breafast Skippers (n=152) Median	Breafast Skippers (n=152) IQR	*P* Value
Daily % calories from fat	38.1	9.5	37.5	9.4	40.2	8.1	.0001
Breakfast % calories from fat	28.2	22.2	28.2	22.2	NA	NA	NA
Daily cholesterol (mg)	199.7	203.1	205.0	211.6	166.4	147.5	.0032
Breakfast cholesterol (mg)	25.9	61.1	25.9	61.1	NA	NA	NA
Daily sodium (mg)	1894.3	1139.8	1944.4	1117.3	1506.9	933.4	.0001
Breakfast sodium (mg)	408.7	402.2	408.7	402.2	NA	NA	NA

Abbreviations: NA = not applicable and IQR = interquartile range.

TABLE 3. PERCENTAGE OF SAMPLE CONSUMING MORE THAN THE RECOMMENDED AMOUNTS OF SELECT NUTRIENTS BY BREAKFAST-EATING BEHAVIOR

Nutrient	% Sample (N=1151)	% Eaters (n=999)	% Skippers (n=152)	*P* Value
>30% daily calories from fat	87.4	86.4	94.1	.0071
>30% breakfast calories from fat	46.4	46.4	NA	NA
>300 mg cholesterol/day	28.7	30.5	17.0	.0001
>300 mg of cholesterol at breakfast	11.5	11.5	NA	NA

Abbreviations: NA = not applicable.

daily dietary adequacy for vitamins A, B_6, thiamin, riboflavin, niacin, folacin, and iron.

Noncereal breakfast eaters had significantly higher intakes of cholesterol and percentage calories from fat both at breakfast and over the 24-hour period, and significantly more sodium at breakfast compared to cold cereal breakfast eaters (Tables 5 and 6). Hot cereal breakfast eaters had significantly higher percentage calories from fat and sodium intake at breakfast than cold cereal breakfast eaters.

Anthropometrics

The height and weight of the study children were comparable to the NCHS standards; weight-for-age and height-for-age did not differ between breakfast eaters and breakfast skippers. The prevalence of obesity, defined as body mass index (weight/height^2) >85th percentile,[18] was 17.8% (males 23.5% and females 11.7%; $P<.0001$), and the prevalence of superobesity, defined as body mass index >95th percentile,[18] was 17.9% (males 16% and females 19.8%; $P=.13$). The prevalence of obesity and superobesity did not vary by breakfast-eating behavior.

DISCUSSION

In this study on the breakfast-eating behaviors of more than 1000 predominantly low-income, African-American elementary school children, 22% to 26% reported not eating before arriving at school on a self-administered questionnaire while 12% reported not eating on 24-hour dietary recall. Children who ate breakfast were more likely than those who skipped breakfast to achieve 24-hour dietary adequacy for calories, protein, vitamins A, B_6, C, D, E, thiamin, riboflavin, niacin, folacin, calcium, magnesium, and iron. A significantly higher proportion of the children skipping breakfast had 24-hour intakes below 50% RDA for all nutrients studied than did the children who ate breakfast.

The validity of the 24-hour food recall as an accurate measure of an individual's usual food intake has been questioned.[19] Although the ability of children in grades one through four to recall a school lunch has been shown to be good, accuracy increased with age to 80% correct recall of foods eaten by children in grade four.[20] Furthermore, several studies have demonstrated the validity of the 24-hour dietary recall in assessing the dietary intake of groups of individuals.[21] In this study, second-grade children reported age-specific intakes for macronutrients and most micronutrients that were similar to those reported by children in the higher grades.

TABLE 4. PERCENTAGE OF CHILDREN WITH DAILY NUTRIENT INTAKES <80% OF RECOMMENDED DIETARY ALLOWANCE (RDA) BY BREAKFAST TYPE*

Nutrients	% Consuming <80% of RDA			Groups Significantly Different ‖
	Noncereal (1)†	Hot Cereal (2)‡	Cold Cereal (3)§	
Calories	44.4	43.3	48.3	None
Protein	2.6	0.6	1.5	None
Vitamin A	63.8	34.5	50.3	1 & 2; 1 & 3; 2 & 3
Vitamin D	94.9	95.1	84.5	1 & 3; 2 & 3
Vitamin E	48.5	34.5	47.3	1 & 2; 2 & 3
Vitamin C	24.2	24.6	14.8	1 & 3; 2 & 3
Vitamin B_{12}	5.7	4.7	1.8	1 & 3; 2 & 3
Vitamin B_6	62.4	34.5	28.3	1 & 2; 1 & 3
Thiamin	22.9	5.8	6.3	1 & 2; 1 & 3
Riboflavin	14.2	6.4	0.5	1 & 2; 1 & 3; 2 & 3
Niacin	24.3	9.9	4.0	1 & 2; 1 & 3; 2 & 3
Folacin	30.0	12.9	2.3	1 & 2; 1 & 3; 2 & 3
Calcium	42.1	26.9	36.3	1 & 2; 2 & 3
Magnesium	26.7	32.2	21.3	2 & 3
Iron	45.4	11.7	19.3	1 & 1; 1 & 3; 2 & 3

*Analysis by breakfast type excludes five children who consumed both hot and cold cereal.
†n = 432.
‡n = 171.
§n = 400.
‖ Significant at $P<.05$.

The 22% to 26% proportion of children who reported eating no morning meal in East Orange on a given study day by self-administered questionnaire is similar to the 22% to 25% reported by low-income elementary school children in Lawrence, Massachusetts.[1] The 12% proportion who reported skipping breakfast on interviewer-administered 24-hour dietary recall is similar to the 15% to 18.5% reported in the National Evaluation of School Nutrition Programs (NESNP),[9] and higher than the 9.4% recently reported for white third- and fourth-grade students in rural upstate New York (of whom only 9.3% resided in single-parent families[22]) and the 1.5% of children aged 5 to 12 years in middle to upper-middle class, two-parent families in Michigan.[23] Breakfast skipping thus appears to be a more prevalent behavior among low-income and minority school children. The reasons for the difference in the results of the two methods of determining breakfast-eating behavior are unclear. Children may overreport 24-hour breakfast consumption in the presence of an adult interviewer.

The finding that up to one fourth of low-income children are attending school without having eaten a morning meal carries important educational implications. It has been shown that morning cognitive test performance of well-nourished elementary school children is significantly better in the fed state compared with their performance in the fasted state.[7,8] Furthermore, the dietary micronutrient deficiencies associated with children's skipping breakfast demonstrated in this and other studies may carry additional adverse consequences for cognitive function.[24]

The dietary consequences of breakfast skipping were seen among nearly all nutrients studied, similar to the findings of the NESNP.[9] The magnitude of these dietary deficits may be clinically important. For children who skipped breakfast, nearly three fourths failed to consume ⩾80% of the RDA for energy, and one fourth of these children consumed <50% RDA (compared with breakfast eaters, less than half of whom took in <80% RDA for energy, and only 6% of whom consumed <50% RDA). It is possible that such deficits may contribute to the persistently higher prevalence of short stature among low-income, school-age children in the United States, although an association between poverty-related growth deficit and reduced energy (or other

TABLE 5. PERCENTAGE OF CALORIES FROM FAT, CHOLESTEROL, AND SODIUM BY BREAKFAST TYPE

Nutrient	Noncereal (1)* Median	Noncereal (1)* IQR	Hot Cereal (2)† Median	Hot Cereal (2)† IQR	Cold Cereal (3)‡ Median	Cold Cereal (3)‡ IQR	Groups Significantly Different§
Daily % calories from fat	39.2	9.7	36.4	10.2	36.2	9.5	1 & 2; 1 & 3
Breakfast % calories from fat	38.8	24.8	27.3	23.8	23.0	13.5	1 & 2; 1 & 3; 2 & 3
Daily cholesterol (mg)	250.7	300.9	186.9	182.3	183.2	139.6	1 & 2; 1 & 3
Breakfast cholesterol (mg)	48.5	264.3	16.7	50.2	17.8	16.5	1 & 2; 1 & 3
Daily sodium (mg)	1977.3	1112.6	1963.0	978.3	1919.7	1089.1	None
Breakfast sodium (mg)	410.2	464.3	507.4	433.2	342.0	344.0	1 & 2; 1 & 3; 2 & 3

*n = 423.
†n = 171.
‡n = 400.
§Significant at $P<.05$.

TABLE 6. PERCENTAGE OF SAMPLE CONSUMING MORE THAN THE RECOMMENDED AMOUNTS OF SELECT NUTRIENTS BY BREAKFAST TYPE

Nutrient	% Consuming > Recommended Amount: Noncereal (1)*	Hot Cereal†	Cold Cereal‡	Groups Significantly Different§
>30% daily calories from fat	89.6	83.0	84.3	1 & 2; 1 & 3
> breakfast calories from fat	68.2	43.9	23.8	1 & 2; 1 & 3; 2 &3
>300 mg cholesterol/day	43.5	25.1	28.8	1 & 2; 1 & 3
>300 mg cholesterol at breakfast	18.6	12.9	3.0	1 & 3; 2 & 3

*n = 423.
†n = 171.
‡n = 400.
§Significant at $P<.05$.

nutrient) intake has not been clearly established.[3] Breakfast skipping contributed to deficits of similar magnitude for iron and calcium, which are of special concern in view of the well-established, detrimental impact of iron deficiency on cognitive function in children[25,26] and in view of recent evidence that dietary calcium intake is related to peak bone mass.[27]

Although fewer breakfast eaters consumed <80% RDA for vitamin D than breakfast skippers, more than 90% of both groups failed to achieve dietary adequacy. Although vitamin D_3 is produced in human skin exposed to ultraviolet radiation, limitations of this exposure by many factors (including area and duration of skin exposure to sunlight, latitude of residence, season of year, melanin content of the skin, air pollution, and use of sunscreens) render dietary sources of vitamin D essential for most individuals in the United States.[16,28] Peak bone mass does not occur until the third decade of life, and adequate vitamin D intake is necessary for mineral homeostasis and normal skeletal formation. For children, processed cow's milk is the primary dietary source of vitamin D. Three 8-oz glasses of milk contribute approximately 7.5 μg toward meeting the child's daily RDA of 10 μg. Small amounts of vitamin D are provided by solid food sources including eggs, butter, and fortified margarine. Dietary sources are particularly important for African-American children, who synthesize less vitamin D due to higher levels of skin melanin, and for inner-city children, whose exposure to sunlight may be limited.[16] Furthermore, recent recommendations for skin cancer prophylaxis include limiting exposure to sunlight.[29]

SUMMARY

Not eating breakfast results in substantial deficits in dietary intake of a variety of essential nutrients among low-income African-American school children. Efforts to improve the nutritional status of

children should include nutrition education to promote breakfast.

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Literature Cited

1. Meyers A, Sampson A, Weitzman M. Nutrition and academic performance in school children. *Clinics in Applied Nutrition.* 1991;1(2):13-25.

2. US Department of Agriculture, Human Nutrition Information Service. *Nationwide Food Consumption Survey, Continuing Survey of Food Intakes by Individuals. Low-Income Women 19-50 Years and Their Children 1-5 Years, 4 Days.* Hyattsville, Maryland. NFCS, CSFII; 1988. Report no. 85-5.

3. Jones KY, Nesheim MC, Habicht J-P. Influences in child growth associated with poverty in the 1970s: an examination of HANESI and HANESII, cross-sectional US national surveys. *Am J Clin Nutr.* 1985;42:714-724.

4. Pilch SM, Senti FR. *Assessment of the Iron Nutritional Status of the US Population Based on Data Collection in the Second National Health and Nutrition Examination Survey, 1976-1980.* Bethesda, Md: Life Sciences Research Office, Federation of American Societies for Experimental Biology; 1984.

5. Maurer KM. The National Evaluation of School Nutrition Programs: factors affecting student participation. *Am J Clin Nutr.* 1984;40:425-447.

6. Radzikowski J, Gale S. The National Evaluation of School Nutrition Programs: conclusions. *Am J Clin Nutr.* 1984;40:454-461.

7. Pollitt E, Leibel RL, Greenfield D. Brief fasting, stress, and cognition in children. *Am J Clin Nutr.* 1981;34:1526-1533.

8. Pollitt E, Lewis NL, Garza C, Shulman RJ. Fasting and cognitive function. *J Psychiatr Res.* 1982/83;17:169-174.

9. Hanes S, Vermeersch J, Gale S. The National Evaluation of School Nutrition Programs: program impact on dietary intake. *Am J Clin Nutr.* 1984;40:390-413.

10. Dixit S. School breakfast programs: are we making the grade? Presented at the American Dietetic Association Annual Meeting; May 5, 1993; Buffalo, New York.

11. US Bureau of the Census. Washington, DC.*County and City Data Book.* 1989.

12. *Nutriquest II: A Microcomputer-Based Nutrient Analysis System.* Rockville, Md: Capital Systems Group Inc; 1984.

13. Agricultural Research Service, US Department of Agriculture. *Nutritive Value of American Foods in Common Units.* Washington, DC: US Department of Agriculture: 1975.

14. *Tufts Nutrient Database and Coding System.* Boston, Mass: Tufts Nutrient Data Center; 1991.

15. Dean AG, Dean JA, Burton AH, Dicker RD. *Epi Info, Version 5: A Word Processing Database, and Statistics Program for Epidemiology on Microcomputers.* Stone Mountain, Ga: USD Inc; 1990.

16. National Research Council. *Recommended Dietary Allowances.* 10th ed. Washington, DC: National Academy Press; 1989.

17. *SPSS User's Guide.* 3rd ed. Chicago, Ill: SPSS Inc; 1988.

18. Must A, Dallal GE, Dietz WH. Reference data for obesity: 85th and 95th percentiles of body mass index (wt/ht^2) and triceps skinfold thickness. *Am J Clin Nutr.* 1991;53:839-846.

19. Pao EM, Cypel YS. Estimation of dietary intake. In: Brown ML, ed. *Present Knowledge in Nutrition.* 6th ed. Washington, DC: International Life Sciences Institute-Nutrition Foundation; 1990:399-406.

20. Emmons L, Hayes M. Accuracy of 24-hr recalls of young children. *J Am Diet Assoc.* 1973;62:409-415.

21. Krantzler NJ, Mullen BJ, Comstock EM, et al. Methods of food intake assessment—an annotated bibliography. *J Nutr Educ.* 1982;14:108-119.

22. Lindeman AK, Clancy KL. Assessment of breakfast habits and social/emotional behavior of elementary school children. *Journal of Nutrition Education.* 1990;22:226-231.

23. Morgan KJ, Zabik ME, Leveille GA. The role of breakfast in nutrient intake of 5- to 12-year-old children. *Am J Clin Nutr.* 1981;34:1418-1427.

24. Eysenck HJ, Eysenck SBG, eds. Improvement of IQ and behavior as a function of dietary supplementation: a symposium. *Personality and Individual Differences.* 1991;12:329-365.

25. Lozoff B. Behavioral alterations in iron deficiency. *Adv Pediatr.* 1988;35:331-360.

26. Haas JD, Fairchild MW. Summary and conclusions of the International Conference on Iron Deficiency and Behavioral Development, October 10-12, 1988. *Am J Clin Nutr.* 1989;50:703-705.

27. Johnston CC, Miller JZ, Slemenda CW, et al. Calcium supplementation and increases in bone mineral density in children. *N Engl J Med.* 1992;327:82-87.

28. Norman AW. Vitamin D. In: Brown ML, ed. *Present Knowledge in Nutrition.* 6th ed. Washington, DC: International Life Sciences Institute, Nutrition Foundation; 1990.

29. Weinstock MA, Colditz GA, Willett WC, et al. Nonfamilial cutaneous melanoma incidence in women associated with sun exposure before 20 years of age. *Pediatrics.* 1989;84:199-204.