

ANNOTATED BIBLIOGRAPHY
Research on the Impacts of Breakfast on Children and Adolescents

- 1) **Affenito SG, Thompson DR, Barton BA, Franko DL, Daniels SR, Obarzanek E, Schreiber GB, Striegel-Moore.** “Breakfast Consumption by African-American and White Adolescent Girls Correlates Positively with Calcium and Fiber Intake and Negatively with Body Mass Index.” *Journal of the American Dietetic Association* 2005;105:938-945.

The authors, researchers at Saint Joseph College, Maryland Medical Research Institute, Northeastern University, Children’s Hospital Medical Center, Wesleyan University, and the National Heart, Lung, and Blood Institute, use data from the National Heart, Lung, and Blood Institute Growth and Health Study, a 9-year, longitudinal biracial cohort study with annual 3-day food records, to describe age- and race-related differences in breakfast consumption and to examine the association of breakfast intake with dietary calcium, fiber and Body Mass Index. The 2,379 study subjects were 1,166 white and 1,213 African American girls ages 9 or 10 years.

The subjects’ data regarding race and highest level of parental education were collected upon entering the study. Data collected annually included BMI by trained examiners, dietary intake from 3-day food records administered by dietetics professionals, and physical activity through the Habitual Activity Questionnaire. Breakfast was defined as any eating that occurred between 5 a.m. and 10 a.m. weekdays and 5 a.m. – 11 a.m. weekends. A model using the generalized estimating equations method was used to analyze the data.

The number of days breakfast was eaten tended to decrease with increasing age for all subjects. However, white girls reported eating breakfast more frequently than African American girls. Seventy-seven percent of white 9-year-old girls and 57 percent of African American girls ate breakfast on all 3 days, while 32 percent and 22 percent of 19-year-olds in each respective group ate breakfast all 3 days. Frequency of breakfast eating was found to be significantly associated with higher calcium and fiber intake. In one statistical model, after adjusting for site, race, age, and race-by-age and site-by-age interactions, breakfast eating frequency was a significant predictor of BMI: girls who ate breakfast more consistently had lower BMI. However, BMI was not a significant predictor in other statistical models.

- 2) **Albertson AM, Anderson GH, Crockett SJ, Goebel MT.** “Ready-to-Eat Cereal Consumption: Its Relationship with BMI and Nutrient Intake of Children Aged 4 to 12 Years.” *Journal of the American Dietetic Association* 2003;103:1613-1619.

The authors, researchers with The Bell Institute of Health and Nutrition, General Mills and the University of Toronto, examine the relationship between ready-to-eat cereal consumption and body mass index of a sample of 603 children aged 4 to 12 years. The researchers collected a 14 day self-reported food diary from each household in the study as well as height and weight measurements.

Children who consumed eight or more servings of cereal had lower mean BMIs than children who ate three or fewer servings in all age groups. Also, the

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proportion of children who were at risk for overweight or overweight was significantly lower among children who consumed the most cereal. A statistically significant inverse relationship was found to exist between the population at risk for being overweight and frequency of cereal consumption.

- 3) **Barton BA, Elderidge AL, Thompson D, Affenito SG, Striegel-Moore RH, Franko DL, Albertson AM, Crockett SJ. “The Relationship of Breakfast and Cereal Consumption to Nutrient Intake and Body Mass Index: the National Heart, Lung, and Blood Institute Growth and Health Study.” *Journal of the American Heart Association* 2005;105(9):1383-1389.**

The authors, researchers at Maryland Medical Research Institute, General Mills, Saint Joseph College, Wesleyan University and Northeastern University, describe changes in breakfast and cereal consumption of girls ages 9 to 19 years, and examine the association of breakfast and cereal intake with BMI and consumption of nutrients. They use data from the National Heart, Lung, and Blood Institute Growth and Health Study, a 9-year, longitudinal biracial cohort study with annual 3-day food records, with 2,379 girls (1,166 white and 1,213 black), ages 9 and 10 at baseline from California, Ohio and Washington, DC.

The authors analyzed three-day food records, height, weight, and age data. The researchers found that girls who consumed breakfast on each of the three days had lower BMIs than girls who skipped breakfast on all or most days. The same was true for girls who ate cereal. As girls grew older, BMI increased, but cereal eaters were leaner than girls who did not eat cereal, regardless of age.

- 4) **Bellisle F. “Effects of Diet on Behaviour and Cognition in Children.” *British Journal of Nutrition* 2004;92 (Suppl 2), S227-S232.**

The author presents a review of the literature on diet, behavior and cognitive function in children. The review looks at behavior and effects on cognition based on diet and at short-term vs. long-term effects of diet. She mentions attention-deficit/hyperactivity disorder as a condition that could be affected by intake of sugar or additives. She also reviews studies linking hyperactivity and sugar intake or the presence of food additives in the diet. According to one study, behavioral problems have been reported in thiamin-deficient adolescents with symptoms of irritability, aggressive behavior and personality changes.

She concludes that performance on demanding mental tasks improves following glucose ingestion, while easy tasks are not affected. Glucose improves attention and reaction to frustration in children, according to one study. The author stresses that, although omitting breakfast often interfered with cognition and learning, this effect was more pronounced in nutritionally at-risk children than in well-nourished children. Likewise, the author finds that it is possible to improve IQ scores in young people with micronutrient supplementation only if the subject has a poor diet. The clearest effects of nutritional manipulations on cognitive efficiency and behavior are obtained in young people with poor nutritional status.

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- 5) **Boutelle K, Neumark-Sztainer D, Story M, Resnick M. “Weight Control Behaviors Among Obese, Overweight, and Nonoverweight Adolescents.” *Journal of Pediatric Psychology* 2002;27:531-540.**

The authors, researchers at the University of Minnesota, evaluate weight control and other eating behaviors in obese, overweight and nonoverweight adolescents. A sample of 8,330 adolescents in grades 7, 9 and 11 in public schools in Connecticut participated in a survey of adolescent health in 1995-1996, The Voice of Connecticut Youth Survey (CYS). Researchers obtained data on height and weight and responses to questions about weight control behaviors, healthy eating behaviors, breakfast consumption and physical activity.

The prevalence of usual breakfast consumption was inversely related to overweight status. Overweight adolescents were less likely to eat breakfast than nonoverweight youths. Obese boys and girls and overweight boys were also less likely to eat breakfast than nonoverweight youths. More than half (53 percent) of the nonoverweight girls reported usually eating breakfast compared to only 43 percent of obese girls. In boys, 67 percent of nonoverweight boys usually ate breakfast while 57 percent of boys who were obese did the same and 59 percent of overweight boys ate breakfast regularly. Less than two-thirds of boys and less than half of the girls reported that they usually ate breakfast on a school day.

- 6) **Briefel R, Murphy M, Kung S, Devaney B: “Universal-Free School Breakfast Program Evaluation Design Project. Review of the Literature on Breakfast and Learning. Final Report.” Princeton, NJ, Mathematica Policy Research, USDA Contract No 53-3198-7-006, Dec. 1999.**

This report provides background information on the School Breakfast Program, and key features of a demonstration and evaluation mandated by the 1998 Child Nutrition Reauthorization Act of the effects of providing free breakfasts to all elementary school children. The numerous studies abstracted for the Universal-Free School Breakfast Program (USBP) Design Project Literature Review are included. These 61 studies are reviewed as they relate to (1) the link between nutrition and cognitive development of children, (2) the contribution of breakfast to children’s dietary intake and behavioral and cognitive development, and (3) the relationship between school breakfast, dietary status, and school performance and achievement.

The authors refer to recent studies which indicate a decline in breakfast consumption for children and adolescents over the past 25 years. In terms of socioeconomic characteristics, one-fourth of low-income children went to school without having had breakfast in one study. There was a consistent finding of studies that breakfast makes a significant contribution to nutrient intake over 24 hours; total daily intakes of food energy and other nutrients were significantly lower for children who did not consume breakfast. The evidence reviewed, in terms of cognitive effects, suggests that skipping breakfast interferes with cognition and learning, and that this effect is more pronounced in poorly nourished children. Existing research suggests that breakfast omission does affect the performance of specific cognitive tasks, particularly those involving memory.

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Mood, behavior, health status, and certain types of attention are also affected by skipping breakfast.

The authors cite many studies finding that universal school breakfast program participation is associated with higher rates of attendance and declines in tardiness. They mention mixed estimated effects of school breakfast participation on academic achievement, referring to studies where scores increased on the total test, but not subtests, or math scores improved where reading scores did not, and Jamaican studies that show a link between participation and cognitive functioning. A few studies also associate breakfast participation with children's psychosocial outcomes such as lower levels of anxiety, hyperactivity, childhood depression, and psychosocial dysfunction.

- 7) **Chandler AMK, Walker SP, Connolly K, Grantham-McGregor SM. "School Breakfast Improves Verbal Fluency in Undernourished Jamaican Children." *Journal of Nutrition* 1995;125(4): 894-900.**

The authors, researchers from the University of the West Indies and the University of Sheffield, examine the short-term effects of breakfast on children's cognitive functions. The subjects, 97 undernourished (≤ -1 SD of reference) and 100 adequately nourished children in grades 3 and 4 in four rural Jamaican primary schools, were randomly assigned to a breakfast or placebo group. They were given four cognitive function tests. The four tests were of: visual search, digit span, verbal fluency, and speed of information processing. The digit span, a simple test of working memory, involves the immediate recall of strings of digits of increasing length. Verbal fluency refers to an individual's capacity to generate items from a specified semantic category. The task involves retrieving items from long-term memory. Heights and weights of each subject were measured, and each child completed a questionnaire to assess socioeconomic status.

After a few weeks, the treatments were reversed and the tests repeated as part of the study's cross-over design. Children in the breakfast group were given chocolate milk and a cheese sandwich while those in the placebo group received a quarter of an orange; the orange piece was not a true placebo, but acted as a control for any extra attention that the children given breakfast might receive. They were fed at 8:30 a.m. and testing was conducted from 9:00 a.m. to 12:00 p.m. by testers blind to each child's treatment and nutritional status. Undernourished children's performance improved significantly on a test of verbal fluency when they received breakfast, while that of the adequately nourished children did not change.

In the other three tests, children respond to visual or auditory stimuli. In the verbal fluency test, children must recall information, and this test also involves initiating and maintaining a mental process in the absence of any externally based organization. This means that the difference in the effect of school breakfast on verbal fluency scores may indicate that undernutrition has a primary effect on motivation.

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- 8) **Cohen B, Evers S, Manske S, Bercovitz K, Edward HG. “Smoking, Physical Activity and Breakfast Consumption among Secondary School Students in a Southwestern Ontario Community.” *Canadian Journal of Public Health* 2003;94:41-44.**

The authors, researchers from the University of Guelph and University of Waterloo, both in Ontario, Canada, investigate the prevalence of smoking, low levels of physical activity, and missing breakfast to see if these behaviors are related and if there are gender differences. A sample of 318 students in grades 9 through 12 in three schools in southwestern Ontario completed surveys administered by teachers in grade 10 English classes.

Less than half (42.8 percent) of the students ate breakfast every day, and missing breakfast was more common among girls (63.9 percent). Among boys, nearly twice as many non-smokers, 60.4 percent, ate breakfast than smokers, 31.9 percent. There was no difference in daily breakfast consumption between girls who smoked and girls who did not smoke. Students who ate breakfast daily were more likely to participate in physical activity three or more times a week than breakfast skippers.

A higher proportion of girls concerned about gaining weight were more likely to skip breakfast (70 percent) than girls who were not concerned (51 percent). Girls concerned about gaining weight were also less likely to engage in physical activity or smoke.

- 9) **Cook JT, Ohri-Vachaspati P, Kelly GL. “Evaluation of a Universally-Free School Breakfast Program Demonstration Project, Central Falls, Rhode Island.” Center on Hunger, Poverty and Nutrition Policy, Tufts University, Medford, MA, 1996.**

Tufts University researchers prepare a “rapid assessment” evaluation to examine whether the shift from the regular School Breakfast Program to the Universally-Free School Breakfast Program, entitled “Operation Breakfast,” had an effect on school breakfast participation, morning nutrient intake, absenteeism and tardiness.

Using a sample of 225 students in grades Pre-K through 6 in Central Falls, RI, school district, and a control group sample of 225 students from Providence, RI, schools, they obtained data from interviews, school attendance and tardiness records, and nutrient content of breakfasts.

They found that participation in school breakfast increased nearly 60 percent among Central Falls students compared to the control group after the universally-free program was implemented, and the proportion of children in poor families participating increased 71 percent.

Tardiness rates declined significantly in intervention schools. The proportion of children chronically tardy (tardy on more than 10 percent of days) decreased by 67 percent in treatment schools, and increased by 50 percent in control schools. The proportion of children not eating breakfast declined by 36 percent in intervention schools after implementation of the universally-free program.

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10) Cueto S. “Breakfast and Dietary Balance: the enKid Study, Breakfast and Performance.” *Public Health Nutrition* 2001;4(6A):1429-1431.

This review analyzes studies examining the effect of breakfast consumption on energy availability, nutritional status, school attendance and performance. The author suggests that the effect of fasting on academic performance is not the same for each child, but depends on the child’s nutritional status.

Breakfast consumption had a short-term effect in improving selected learning skills, especially work memory. School breakfast programs had a positive effect on the nutritional status of children, on school attendance and, most likely, on dropout rates, according to studies conducted in Jamaica, Peru and the United States – Baltimore and Philadelphia. However, it was not enough that students have better nutritional status and they attend school. Apparently all students having school breakfast were in a better condition to perform at school, but whether this benefit can definitely be obtained depended on the school environment (well-illuminated, aired rooms; enough space; adequate teaching; etc.)

The effect of breakfast consumption on school performance depended on the interaction between the program, student characteristics, and school organization. Unless the school setting guaranteed a minimum quality standard, the benefits of breakfast consumption were not evident in performance in complex areas like language or math.

11) Fiore H, Travis S, Whalen A, Auinger P, Ryan S. “Potentially Protective Factors Associated with Healthful Body Mass Index in Adolescents with Obese and Nonobese Parents: A Secondary Data Analysis of the Third National Health and Nutrition Examination Survey, 1988-1994.” *Journal of the American Dietetic Association* 2006;106:55-64.

The authors, researchers from the University of Rochester and Yale School of Medicine, use data from a sample of 1,890 adolescents ages 12-16 from the Third National Health and Nutrition Examination Survey, 1988-1994 (NHANES III), to identify potentially protective factors against obesity in adolescents with and without obese parents. The data included height, weight, a 24-hour dietary recall, frequency of breakfast consumption, physical and lifestyle characteristics, arithmetic and reading tests, and parental BMI. Bivariate analyses were used to examine the association between variables using SPSS and SUDAAN software.

The researchers found from data analysis that adolescents eating breakfast every day had healthful BMIs (between the $\geq 15^{\text{th}}$ and $< 85^{\text{th}}$ percentile of study participants) when compared with those eating breakfast rarely. In addition, adolescents with one or two obese parents who ate breakfast some days or every day were significantly more likely to have healthful BMIs than those who ate breakfast rarely. This study examined these associations using a large nationally representative sample, allowing the results to be applicable to more people.

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**12) Gleason P, Sutor C. “Food for Thought: Children’s Diets in the 1990s.”
Mathematica Policy Research, Inc.: Princeton, NJ. March 2001.**

The authors, a senior researcher at Mathematica Policy Research, Inc, and a nutrition policy consultant in Northfield, Vermont, summarize two studies of children’s nutrition conducted by Mathematica Policy Research, Inc., for the Food and Nutrition Service of the USDA using the 1989-1991 and 1994-1996 Continuing Survey of Food Intakes by Individuals (CSFII). The goal of the policy brief was to describe the diets of school-age children in the mid-1990s, examine relationships between their participation in the school meal programs and dietary intake, and examine changes in their intake between 1989-1991 and 1994-1996. The analysis used data for more than 5,000 children ages six to 18 who completed the CSFII dietary intake interviews in either period.

The authors found that children consumed too much dietary fat and sodium, and a large proportion of their food energy came from added sugars. Children who ate a school lunch got 15 percent of their lunch calories from saturated fat and 13 percent from added sugars. Those who did not eat a school lunch got 11 percent of their lunch calories from saturated fat but got 23 percent from added sugars.

Most children consumed enough vitamins and minerals, but many children were at risk of inadequate intakes of vitamins A and E, zinc, folate, and magnesium. Most children ate fewer than the Food Guide Pyramid - recommended three servings of vegetables, two servings of fruit, and two servings of meat or meat alternates. However, those who participated in both school breakfast and lunch programs came closer to meeting the “five-a-day” goal for fruit and vegetable consumption, with 4.5 servings a day, than nonparticipants, with 3.8 servings a day. In terms of beverage consumption, students who ate a school lunch drank about three times as much milk at lunchtime, but only half as much soda as those who did not eat a school lunch.

13) Grantham-McGregor S, Chang S, Walker S. “Evaluation of School Feeding Programs: Some Jamaican Examples.” *American Journal of Clinical Nutrition* 1998;67(4) 785S-789S. (See #7 for related findings.)

The authors, researchers from the Centre for International Child Health, University of London, and University of the West Indies, test the hypothesis that a daily school breakfast can improve children’s academic achievement. The subjects in the sample, 100 undernourished and 100 adequately nourished 8-11 year-old schoolchildren in grades 3 and 4 from four rural Jamaican schools, were randomly assigned to receive breakfast or a slice of orange as a placebo for one week. Two weeks later the treatment was reversed for one week in this crossover study. All subjects were given four cognitive function tests: visual search, digit-span forwards (which measures auditory working memory), categoric fluency (which measures an individual’s capacity to generate items from a specific category, for example naming as many items as possible from two sets: animals and things to eat), and speed of decision making. Classroom behavior was also observed in 60 undernourished and 60 adequately nourished children after

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treatment or placebo where talking, moving without permission, answering the teacher's questions, and time spent paying attention were recorded.

The undernourished children performed better after they received breakfast, significantly so on the categoric fluency test, while adequately nourished children had no change in scores. Overall there were no effects of treatment on classroom behavior in the schools. However, in one school, the children's attention to a task increased significantly with breakfast, while attention at other schools did not change significantly. In two other schools, behavior deteriorated significantly with breakfast and children were less attentive to set tasks. The researchers note that the facilities were different at each school; the school that saw improvement in classroom behavior had the best facilities while the two that saw a decline had less space and more crowded rooms. Cognitive function improved in the undernourished children when they received breakfast, but not in the adequately nourished children. The authors hypothesize that undernourished children's cognitive function improves with breakfast, but changes in behavior seem to depend on the school structure and facilities.

- 14) Gross SM, Bronner Y, Welch C, Dewberry-Moore N, Paige DM. "Breakfast and Lunch Meal Skipping Patterns among Fourth-Grade Children from Selected Public Schools in Urban, Suburban, and Rural Maryland." *Journal of the American Dietetic Association* 2004;104(3):420-3.**

The researchers, from Morgan State University, Johns Hopkins University, and Fox Chase Cancer Center, describe breakfast and lunch consumption patterns in a sample of 540 fourth-grade public school children from 16 Maryland public schools in rural, suburban and urban regions using an in-classroom questionnaire in which they reported the number of days per week they ate breakfast and/or lunch. Seventeen percent of the students reported skipping breakfast at least three times per week. Urban students (27 percent) were more than twice as likely to skip breakfast as suburban (8 percent) and rural (13 percent) students.

- 15) Jacoby E, Cueto S, Pollitt E. "Benefits of a School Breakfast Program among Andean Children in Huaraz, Peru." *Food and Nutrition Bulletin* 1996;17:54-64.**

The authors, researchers from University of California at Davis and the Instituto de Investigación Nutricional, Lima, Perú, conduct a randomized, controlled trial to measure the short-term impact of school breakfast on diet, attendance, and cognition in schoolchildren from 10 rural schools in Huaraz, Peru, in grades 4 and 5. Each school was randomly assigned to a treatment or control group. The data showed increased dietary intakes of energy, protein, and iron, as well as improved rates of attendance and performance on a vocabulary test. The study was an effectiveness trial, conducted under the 'real-world' conditions of the school setting. The researchers used a 24-hour recall method to determine dietary intake, records from teachers on attendance, and six tests, three on cognitive processes and three on complex mental abilities. Data was also collected on socio-economic status and individual characteristics of the child.

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Eating breakfast had a significant positive effect on vocabulary test performance, and among the students in the treatment group, weight was positively associated with improved vocabulary test scores. Attendance increased among treatment schools, and declined among control schools with a statistically significant inter-group difference. Because of its effects on attendance, it is possible to infer that the breakfast program could be an incentive to keep children in school, a major problem in the educational system in Peru.

- 16) Jones SJ, Jahns L, Laraia BA, Haughton B. “Lower Risk of Overweight in School-aged Food Insecure Girls Who Participate in Food Assistance: Results from the Panel Study of Income Dynamics Child Development Supplement. *Archives of Pediatric and Adolescent Medicine* 2003;157:780-84.**

The authors, researchers from the University of Tennessee and University of North Carolina at Chapel Hill, use data from the 1997 Panel Study of Income Dynamics Child Development Supplement (PSID CDS), to compare 5 to 12 year-old children, in terms of gender, prevalence of overweight (BMI \geq 85th percentile), food insecurity status, and participation in food assistance programs. In the sample of 772 low-income families with at least one child meeting age and BMI requirements, Stata software was used to calculate prevalence of risk of overweight as compared to food security status and food assistance participation. Girls in food insecure households had significantly reduced odds (68 percent) of being at risk of overweight if they participated in school lunch and breakfast programs.

- 17) Kleinman RE, Hall S, Green H, Korzec-Ramirez D, Patton K, Pagano ME, Murphy JM. “Diet, Breakfast, and Academic Performance in Children.” *Annals of Nutrition & Metabolism* 2002;46(suppl 1):24-30.**

The authors, researchers from Harvard Medical School, Massachusetts General Hospital, Boston Public Schools, Project Bread/The Walk for Hunger, and Brown University, test whether nutrient intake and academic and psychosocial functioning improve after the start of a universal-free school breakfast program (USBP). They gather nutrition, school breakfast participation, hunger status and academic grade information from 97 students in grades 4 to 6 in Boston public schools for one week before and one week after a 6 month implementation of universal-free school breakfast program. They found improved math scores, attendance, nutritional status, behavior and psychosocial functioning, and increased participation, especially for students deemed ‘at nutritional risk’ by a hunger status questionnaire.

- 18) Mahoney CR, Taylor HA, Kanarek RB, Samuel P. “Effect of Breakfast Consumption on Cognitive Processes in Elementary School Children.” *Physiology & Behavior* 2005;85:635-645.**

Studying the relationship between breakfast composition and cognitive performance in elementary school children, the authors, researchers at Tufts University and the Quaker Oats Company, conducted two experiments to examine how instant oatmeal, ready-to-eat cereal and no breakfast affect American

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children's cognition. Subjects received either oatmeal, ready-to-eat cereal or no breakfast one day a week for four weeks after filling out a mini-questionnaire. Their parents were instructed not to feed the children after 10:00 p.m. the night before and reminded by phone call not to provide breakfast in the morning. Experimenters blind to the breakfast conditions administered tests in spatial memory, short-term memory, visual perception, visual attention, and auditory attention.

In the trial with 15 male and 15 female middle class, 9-11 year-olds in the United States, both genders showed enhanced spatial memory and girls had improved short-term memory after consuming oatmeal. In the second trial, 15 male and 15 female middle class, 6-8 year-olds in the United States, boys and girls had better spatial memory and auditory attention and girls showed better short-term memory after an oatmeal breakfast. Performance in visual perception and spatial memory tasks was significantly better after consuming either breakfast than no breakfast at all.

19) McLaughlin JE, Bernstein LS, Crepinsek MK, Daft LM, Murphy JM. "Evaluation of the School Breakfast Program Pilot Project: Findings from the First Year of Implementation." U.S. Department of Agriculture, Food and Nutrition Service 2002. Report No. CN-02-SBP.

This was a congressionally mandated study to assess the implementation and impact of a three-year universal-free breakfast demonstration. The study sample included 153 schools: 79 treatment schools and 74 control schools with a total of 4,290 children, grades 2-6, with 30 students per school. The schools were in six school districts in Alabama, Arizona, California, Idaho, Kansas and Mississippi and included urban and rural schools with varying family income levels.

Outcome variables included rate of participation, skipping breakfast, consuming a nutritionally substantive breakfast, participation of breakfast in classrooms vs. in the cafeteria, as well as academic performance, attendance, tardiness, prevalence of overweight, behavior, and nutrient intake. Data was collected through in-person interviews with students to obtain 24-hour dietary recall, breakfast intake, source, pattern attitudes, participation and plate waste. Cognitive function tests were administered, including Stimulus Discrimination, Digit Span, and Verbal Fluency. Height and weight measurements, in-person interviews with parents, questionnaires completed by teachers, and school records were also collected. Federal nutrition standards for breakfast were maintained for each school, but each treatment school was free to determine what would be served for breakfast as well as how, when, and where it would be served.

School breakfast participation increased significantly more in treatment schools than in control schools, by 17 percentage points (from 19 to 36 percent) as opposed to 1 percentage point (from 19 to 20 percent). Participation increased by 33 percentage points in one school district in treatment schools where students ate breakfast in the classroom. When breakfast was defined as providing at least 10 percent of the RDA for food energy and food from two different food groups, treatment school students were significantly more likely than controls to consume breakfast. No significant differences were found for any of the cognitive tests, nor

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were impacts discovered from a Pediatric Symptom Checklist (PSC). There were no significant effects in attendance or tardiness rates; however, attendance levels were very high before implementation, with 95-96 percent across treatment and control schools. On the Conners' Teachers Rating Scale, there was a significant decrease in oppositional scores for students in the treatment schools. On this scale, individuals scoring high are more likely to break rules and have problems with persons in authority, and are more easily annoyed and angered than most individuals their own age. Treatment school students and parents were significantly more likely to have positive attitudes towards breakfast than students and their parents at control schools.

Among 'changers,' students who increased school breakfast participation by at least 40 percentage points, attendance increased significantly, tardiness decreased significantly, and the students and parents generally had more positive attitudes toward school breakfast.

20) Meyers A, Sampson AE, Weitzman M, Rogers BL, Kayne H. "School Breakfast Program and School Performance." *American Journal of Diseases of Children* 1989;143:1234-39.

The authors, researchers at Boston City Hospital, Boston University School of Medicine, Tufts University School of Nutrition, and Boston University School of Public Health, study changes in scores on standardized achievement tests, The Comprehensive Test of Basic Skills (CTBS) and rates of absence and tardiness after the School Breakfast Program (SBP) is implemented in schools.

In Lawrence, MA public schools, the school breakfast program began at the start of the second semester of the 1986-1987 school year and standardized achievement tests were administered annually. In this school system, 71 percent of the children were low-income and eligible for free or reduced-price school meals. Of these children, 58 percent were Hispanic, 37 percent white non-Hispanic, 2 percent black, and 2 percent Asian. Six of the school district's 16 elementary schools were chosen for the study. All children in grades 3 through 6 were considered eligible for the study if they qualified for free or reduced price lunch, were registered in the Lawrence public schools, and had parental consent. Attendance at school breakfast was monitored for one week to determine participation; students were classified as participants if they attended school breakfast at least 60 percent of days of the week, nonparticipants if they did not attend breakfast on any days, and the remaining children were excluded from the study. The CTBS scores of academic achievement were obtained and attendance and tardiness data were collected from school records. Of the 1023 children in the study sample, 335 (33 percent) were school breakfast participants.

Increases in CTBS total scores after implementation of the School Breakfast Program were significantly greater for school breakfast participants. Tardiness rates decreased significantly for participants and increased for nonparticipants. Absence rates were significantly lower for school breakfast participants after implementation of the School Breakfast Program. The authors find that participation in school breakfast by low-income children has a significant

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association with improvement in standardized achievement test scores and rates of absence and tardiness.

21) Miller G, Forgac T, Cline T, McBean L. “Breakfast Benefits Children in the US and Abroad.” *Journal of the American College of Nutrition* 1998;17:4-6.

This editorial briefly gives a recapitulation of studies relating to breakfast and calcium and other nutrient consumption as well as ability to learn. The authors refer to studies saying that participating in the School Breakfast Program not only improves total daily nutrient intake and nutritional status, but also enhances students’ ability to learn. They also relate that hungry children, regardless of income or socioeconomic status, face difficulties learning. They find that children who eat breakfast make fewer errors on standardized achievement tests, improve in attendance and attention, and are tardy less often. Furthermore, missing breakfast reduces children’s speed and accuracy of information retrieval and memory. The authors conclude that the availability of breakfast for all U.S. students would be instrumental in improving their nutrient status and academic performance.

22) Murphy JM, Wehler CA, Pagano ME, Little M, Kleinman RF, Jellinek MS. “Relationship Between Hunger and Psychosocial Functioning in Low-Income American Children.” *Journal of the American Academy of Child & Adolescent Psychiatry* 1998;37:163-170.

The authors, researchers with the Child Psychiatry Service, Massachusetts General Hospital, Boston, the Community Childhood Hunger Identification Project, and Harvard Medical School, interview 200 low-income public school students with permission of their parents to examine the relationship between food insufficiency and hunger and psychosocial functioning. Looking at the results from the Pediatric Symptom Checklist (PSC), Child Behavior Checklist (CBCL) and the Conners Teacher Rating Scale-39 (CTRS-39), and school records, the researchers found that hungry and at-risk for hunger children were absent, late, hyperactive and had behavioral and attention problems more often than non-hungry children

23) Murphy JM, Pagano M, Nachmani J, Sperling P, Kane S, Kleinman R. “The Relationship of School Breakfast to Psychosocial and Academic Functioning: Cross-sectional and Longitudinal Observations in an Inner-City Sample.” *Archives of Pediatric and Adolescent Medicine* 1998;152:899-907.

The authors, researchers from Massachusetts General Hospital, Harvard Medical School, Northwestern University, Philadelphia School District and Baltimore Public Schools, conduct interviews and collect school breakfast participation and school records information before and four months after a universally free breakfast program is implemented. The goal is to determine if there is a relationship between school breakfast program participation and psychosocial and academic functioning. The Children’s Depression Inventory questionnaire and the Revised Children’s Manifest Anxiety Scale are used to determine depressive and anxiety symptoms respectively. Parents complete the

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Pediatric Symptom Checklist questionnaire to identify children with psychosocial dysfunction and teachers use the Conners' Teacher Rating Scale-39 to assess hyperactivity. From this study involving 133 students in grades 3 through 6 or 8 in the initial sample and 110 in the second interview, the researchers found strong evidence for a relationship between school breakfast participation and academic performance in terms of math grades, attendance and punctuality, as well as psychosocial functioning regarding anxiety level and hyperactivity.

24) Murphy JM et. al. "Maryland Meals for Achievement Year III Final Report." Massachusetts General Hospital, Boston, MA, 2001.

This report provides an evaluation of the third year of the Maryland Meals for Achievement (MMFA) program, encompassing 55 schools in Maryland that served breakfast free to all students in the classroom. The evaluation includes monitoring and assessing the program's relationship to academic outcomes, student behavior, and the learning environment. To measure academic outcomes, school-wide averages of Maryland School Performance Assessment Program (MSPAP) scores, attendance records and other information from school principals are used.

The report finds that participation in school breakfast increased nearly threefold from 27 percent to 72 percent. Surveys completed by more than 90 percent of teaching and non-teaching staff revealed that high percentages (80 percent or more) believed that classroom and learning environments had improved as a result of the breakfast program. Staff members also believed that the program led to decreased numbers of behavior problems in schools.

There were no statistically significant differences in standardized test scores between implementation schools and control schools. However, implementation schools did show larger increases in standardized test scores than control schools.

25) Murphy JM, Pagano M, Bishop SJ. "Impact of a Universally Free, In-Classroom School Breakfast Program on Achievement: Results from the Abell Foundation's Baltimore Breakfast Challenge Program." Massachusetts General Hospital, Boston, MA, 2001.

Researchers examine data and scores were examined for 31 schools in Baltimore that participated in an in-classroom breakfast program for at least two years and a comparison group of 17 schools about to begin universal breakfast programs the next fall.

The relationship between breakfast program status and standardized test scores (Maryland State Pupil Assessment Project (MSPAP) scores), School Performance Index (SPI) scores, and attendance are assessed. Data are analyzed using Oneway and Muliple Analysis of Variance tests.

Universal school breakfast schools had significantly higher attendance following implementation of the free breakfast program. There was no significant difference in *actual* MSPAP or SPI scores between universal free breakfast and comparison schools. However, schools with free breakfast had significantly greater positive *changes* in academic performance scores than comparison schools.

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Schools that provided breakfast without charge for three years improved significantly more in attendance than both comparison schools and schools that participated in the program for two years.

26) Murphy JM, Pagano ME, Patton K, Hall S, Marinaccio J, Kleinman R. “The Boston Public Schools Universal Breakfast Program: Final Evaluation Report.” Massachusetts General Hospital, Boston, MA, 2000.

The authors, researchers at Massachusetts General Hospital and Harvard Medical School, conduct a final evaluation report of the impact of Boston Public Schools’ Universal Breakfast Program on breakfast participation rates, overall satisfaction, and academic and health outcomes. In December 1998, 14 elementary and middle schools in Boston started the Universal Breakfast Program (UBP). The researchers survey 1044 students, parents and school staff to measure overall satisfaction. Interviews were conducted with 97 students and their parents to assess the impact of the program on hunger, nutrition status and emotional functioning. Official student records were used for student grades and absence and tardiness rates. Data from the Boston Public School’s Department of School Food Services records were gathered to measure changes in school breakfast participation rates. The participation and attendance rates were gathered from one week prior to the start of the universal breakfast program and another week after the program had been in place for about six months. The Community Childhood Hunger Identification Project (CCHIP) was used to assess the hunger status of students, 24-hour dietary recalls were used for nutritional assessments, and the Pediatric Symptom Checklist (PSC) and Pediatric Symptom Checklist Youth Self-Report (PSC-Y) were used to measure emotional functioning. Students were considered to be at nutritional risk if they were consuming 50 percent or less of the Recommended Dietary Allowance of two or more major nutrients and/or 50 percent or less of the RDA for energy.

Researchers found that, before universal breakfast was implemented, about one quarter of the students were hungry or at risk for hunger and about one-third were at moderate or serious nutritional risk.

Increased school breakfast participation was associated with improved nutrition status, academic achievement, and math grades, as well as reduced symptoms of hunger, absence and tardiness rates, and fewer emotional or behavioral problems. Students who increased their school breakfast participation rates were two to three times more likely to show an improvement in nutritional status than students whose participation stayed the same or declined. Among the school staff, nearly 60 percent reported a positive change in student behavior and 63 percent reported an improvement in student attentiveness.

School-wide averages on the Massachusetts Comprehensive Assessment System (MCAS) increased three points more in the schools participating in universally free breakfast programs over matched comparison schools. School breakfast participation increased more than 30 percent after the first year of implementation and remained at that rate. The participation rate increased 100 percent in the three schools that implemented a classroom-based approach to serving breakfast. Students who were nutritionally at-risk had significantly lower

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grade point averages, more symptoms of emotional/behavioral problems, and experiences of hunger than better nourished children. More than half of nutritionally at-risk students and two thirds of hungry children prior to universal breakfast implementation increased their participation in school breakfast. These same students who improved their nutritional status also had significantly larger improvements in school attendance and psychological functioning, decreases in hunger, and improvements in math grades, than students who did not improve their nutritional status.

27) Murphy JM, Drake JE, Weineke KM. “Academics & Breakfast Connection Pilot: Final Report on New York’s Classroom Breakfast Project.” Nutrition Consortium of New York State. Albany, New York. July 2005.

This report evaluates 20 schools in upstate New York implementing the Academics & Breakfast Connection (ABC) Pilot in which they served breakfast to all students at no charge, regardless of income, and students consumed their meals in the classroom setting.

Each school designed its own plan for implementing classroom breakfast. Meals were delivered to classrooms in 11 schools; students got meals from a cafeteria line and then took them to classrooms in two schools; students picked up breakfasts at hallway stations in three schools; and four schools used a combination of methods, with one school delivering breakfast to younger students and using a cafeteria line for older students. The schools also differed in menu planning, with some serving both hot and cold meals and some serving only hot or cold meals. To evaluate the program, data were collected on breakfast program participation rates, absence rates, tardiness rates, disciplinary referrals, and visits to the school nurse. Teachers and principals also completed surveys on the effect and impact they perceived from the program.

After schools implemented the pilot program school breakfast participation more than doubled, increasing from 23 percent to 58 percent. Tardiness and disciplinary office referrals decreased significantly. Absence rates and visits to the school nurse also declined, although not reaching statistical significance. Of the principals of the schools involved in the pilot program, 100 percent believed that the pilot made an important contribution to the education process, and 87 percent reported that they believed the pilot program contributed to improvements in academic performance. Nearly 80 percent of teachers at participating schools also thought that the pilot made an important contribution to the education process, 72 percent reported that the pilot did not interfere with teaching, and 85 percent reported fewer complaints of hunger from students. Seventy-nine percent of the teachers supported continuation of the pilot program and 75 percent of the principals reported plans to continue the pilot into the next school year. The authors of the study conclude that classroom breakfast works and that the pilot program resulted in decreased hunger and improvements in factors critical to student learning such as tardiness and disciplinary referral rates.

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- 28) Nicklas TA, Bao W, Webber LS, Berenson GS “Breakfast Consumption Affects Adequacy of Total Daily Intake in Children.” *Journal of the American Dietetic Association* 1993; 93(8):886-891 .**

The authors, researchers from Tulane University Medical Center, School of Public Health and Tropical Medicine, compared daily nutrient intakes of children eating breakfast at home, school, or not at all, using data from the Bogalusa Heart Study. For a sample size of 467 ten-year-old students, 24-hour dietary interviews were conducted and the sample was divided into three groups of children who ate breakfast: at home (41 percent), at school (43 percent), or not at all (16 percent). The 24-hour dietary recall was analyzed using the Extended Table of Nutrient Values (ETNV) and then with the Statistical Analysis System.

The highest percentage of breakfast skipping (24 percent) occurred in black girls. Children who consumed breakfast at school had significantly higher mean daily intakes of energy and protein. A higher percentage of children who skipped breakfast did not obtain two-thirds of the RDA for vitamins A, E, D, and B₆, as well as other minerals studied. The authors conclude that school breakfasts could play a role in correcting some of the dietary inadequacies of school-age children.

- 29) Nicklas TA, Morales M, Linares A, Yang SJ, Baranowski T, De Moor C, Berenson G. “Children’s Meal Patterns Have Changed over a 21-Year Period: The Bogalusa Heart Study.” *Journal of the American Dietetic Association* 2004;104:753-761.**

The authors, researchers at Baylor College of Medicine, University of Houston-Downtown, Houston, TX, University of Texas, and Tulane School of Public Health and Tropical Medicine, analyze children’s meal patterns over two decades. Dietary intake data were collected from 1,584 10-year old children in Bogalusa, LA, from 1973-1994. One 24-hour dietary recall was collected on each child who participated in one of seven cross-sectional surveys.

From 1973 to 1978, there was a significant increase in the percentage of children who skipped breakfast, from 8 percent to 30 percent. The percentages of children skipping breakfast were significant for each gender and ethnic group. When the National School Breakfast Program was introduced in 1981, the proportion of children skipping breakfast declined to 13 percent.

- 30) Pollitt E, Matthews R. “Breakfast and Cognition: An Integrative Summary.” *American Journal of Clinical Nutrition* 1998;67(4):804S-813S.**

The authors of this review of the literature, researchers from the University of California Davis and R. Matthews & Associates, evaluate research design, cognitive functions, scholastic achievement and school attendance, breakfast composition, size and timing and research data. They compare experimental research designs which control for the potential effect of confounders such as the timing and composition of the evening and breakfast meals, duration of fasting, compliance to fasting, and motor activity of the subjects, recommending randomized, controlled crossover designs within this scheme to further minimize intersubject variability by exposing the same subjects to both breakfast and fasting periods. The other studies they examine employ a quasi-experimental

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design, which has some of the features of an experimental design, but does not control for all potentially confounding factors. They determine that, theoretically, breakfast may affect brain function and cognitive test performance by two biological mechanisms, one involving metabolic changes associated with fuel and nutrient supply to the central nervous system, the other involving the changes breakfast may have on nutritional intake and status which could affect cognition. They point to studies focusing on breakfast omission that have found diminished speed and accuracy on tests of visual and auditory short-term memory, immediate recall, delayed recall, recognition memory, and spatial memory. In areas unrelated to memory, breakfast omission was associated with lower performance in a visual discrimination of competing stimuli, a verbal fluency test, and arithmetic tasks.

In terms of academic improvement, three studies reported improved scores on some scholastic tests given in schools participating in a breakfast program. These included improvements in combined scores of language, reading, and math in U.S. low-income students, arithmetic in rural Jamaican schoolchildren, and vocabulary scores in undernourished Peruvian children. In all three studies, participation in the school breakfast program significantly increased school attendance.

Looking at other breakfast components, no change in cognitive performance was observed in a comparison of a cooked compared with a cereal-and-toast breakfast. Breakfast size, or the energy load of the breakfast meal, can play a role, however, as shown in one study where a breakfast which provided 25 percent of the average daily requirements for energy improved performance on a creativity test, compared with children consuming a breakfast with less than 10 percent of daily energy requirements. (Wyon et al. (44)) In terms of timing, one study found that students who ate breakfast 30 minutes before cognitive testing had significantly higher overall cognitive scores than those who did not eat breakfast or ate it at home. (Vaisman et al. (41))

31) Pollitt E. “Does Breakfast Make a Difference in School?” *Journal of the American Dietetic Association* 1995;95(10):1134-39.

This literature review by a University of California Davis researcher examines articles between 1978 and 1995 that test the effects of breakfast on cognition and school performance. The author proposes that two biological mechanisms that operate simultaneously underlie the effects of breakfast on cognitive function: short-term metabolic changes associated with the immediate supply of energy and nutrients to the brain, and the sustained contributions of breakfast to a person’s health status over time. The second mechanism is especially relevant for children who are undernourished.

The author refers to studies where nutritionally at-risk children improved their performance on cognitive tests when they ate breakfast; where consuming breakfast improved students’ performance in spatial memory and immediate recall; where the School Breakfast Program made a difference as to whether children ate breakfast at all; and where eating breakfast had significant effects on arithmetic test scores and school attendance.

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He finds that in children who are nutritionally at-risk (defined by clinical history and anthropometry), skipping breakfast alters brain function and has adverse effects on cognition, particularly in the speed and accuracy of information retrieval in working memory. These consequences were especially true for children lacking iron, while it is unclear whether similar consequences exist for well-nourished children.

32) Pollitt E, Leibel RL, Greenfield D. "Brief Fasting, Stress, and Cognition in Children." *American Journal of Clinical Nutrition* 1981;34:1526-1533.

The authors, researchers at the University of Texas, Rockefeller University and University of Miami, attempt to determine the effects of skipping breakfast on speed and accuracy of response in a problem-solving situation, on sustained attention, and on memory in 9 to 11 year old, well-nourished, middle class children. Twenty-two girls and 12 boys were admitted twice, at about 7 day intervals, to the Clinical Research Center at the Massachusetts Institute for Technology where dinner was served and the next morning half of the sample was served breakfast (BR) and the other half received no breakfast (NBR). Breakfast consisted of waffles and syrup, margarine, orange juice and milk. The children were given cognitive tests, including: the Matching Familiar Figure Test (MFFT), the Continuous Performance Task (CPT), the Hagen Central-incidental Task (HCI), and the Peabody Picture Vocabulary Test (PPVT), which was used to compare IQ as a possible moderating variable. Blood samples were taken from each child the night before the treatment or control and after the tests.

In the memory test, there was a statistically significant difference in the last recall item of the series; the subjects who skipped breakfast performed better. There was a significant association between IQ and MFFT error. For subjects with IQs below the median, the number of errors increased from the breakfast to the no breakfast condition. However, for those subjects with IQs above the median the mean number of errors dropped slightly from breakfast to no breakfast. Subjects whose glucose values fell from the breakfast to the no breakfast condition were likely to have an increase in the number of errors in the MFFT.

Fasting had an adverse effect on the accuracy of responses in problem solving, but it had a beneficial effect on immediate recall in short-term memory. Both effects are explained by a heightened arousal level associated with the brief experimental fast.

33) Pollitt E, Cueto S, Jacoby ER. "Fasting and Cognition in Well- and Undernourished Schoolchildren: A Review of Three Experimental Studies." *American Journal of Clinical Nutrition* 1998;67(4):779S-784S.

The authors, researchers at the University of California Davis and Instituto de Investigación Nutricional, Lima, Perú, tested a hypothesis that an extended fast (overnight and morning, skipping breakfast) interferes with attention and working memory processes. In this blinded study, with a well-nourished American group, and with low income -- with and without nutritional risk-- Peruvian groups, 9-11 year old subjects ate dinner and were randomly assigned to a breakfast or placebo

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group for experiment 1 and to the reverse for experiment 2. The American children completed the Matching Familiar Figures Test and the Hagen Central Incidental Test. Three paper and pencil tests: number discrimination, Peabody Picture Vocabulary Test, and the Raven Progressive Matrices, and three computerized tests (Simple Reaction Time, Stimulus Discrimination, and Sternberg Memory Search Test) were administered to the Peruvian children. Blood samples were also drawn to determine glucose concentrations. U.S. subjects performed better on the matching figures test when given breakfast and for Peruvian children, fasting delayed response time on the stimulus discrimination test. In general, nutritionally at-risk children were more affected by not eating breakfast.

- 34) Powell CA, Walker SP, Chang SM, Grantham-McGregor SM. “Nutrition and Education: a Randomized Trial of the Effects of Breakfast in Rural Primary School Children.” *American Journal of Clinical Nutrition* 1998;68:873-9.**

The authors, researchers from the University of the West Indies, Kingston, Jamaica, randomly assigned 407 undernourished children and 407 adequately nourished children to a breakfast or control group. With a goal of determining the effect of providing a school breakfast on attendance, nutritional status and academic achievement, their randomized and controlled feeding trial showed that eating breakfast improves attendance and achievement in arithmetic.

- 35) Rampersaud GC, Pereira MA, Girard BL, Adams J, Metz J. “Breakfast Habits, Nutritional Status, Body Weight, and Academic Performance in Children and Adolescents.” *Journal of the American Dietetic Association* 2005;105:743-760.**

In this review of the literature, the authors, researchers at the University of Florida, University of Minnesota, Wheat Foods Council, and Cornell Medical College analyze and summarize the results of 47 studies (from 1970-2004) concerning associations between breakfast consumption and nutritional adequacy, body weight, and academic performance. Breakfast eaters tend to have more adequate nutrient intakes, are less likely to be overweight, and have improved cognitive function in terms of memory, test grades, and school attendance. They find that some studies provide evidence that the BMIs of children or adolescents who skip breakfast are higher than those who consume breakfast. They discuss a study in which consuming a school breakfast 30 minutes before testing was helpful to recall. Children at nutritional risk especially benefited from eating breakfast. Observational studies included in the review show a beneficial effect of breakfast consumption on test scores, grades, attendance, and punctuality.

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- 36) Reddan J, Wahlstrom K, Reicks M. “Children’s Perceived Benefits and Barriers in Relation to Eating Breakfast in Schools with or without Universal School Breakfast.” *Journal of Nutrition Education and Behavior*. 2002;34:47-52.**

The authors, researchers at the University of Minnesota, use a teacher-administered survey at the end of a three-year pilot program to identify and compare perceived benefits and barriers related to breakfast consumption and concerns about weight among children in schools with or without universal school breakfast programs. Surveys were given to 1,442 students in grades 4 through 6 in six universal breakfast pilot schools and four control schools.

In the survey, 70 percent of all children reported that they very often think eating breakfast is important, and 23 percent indicated that they sometimes think eating breakfast is important. These findings parallel those of breakfast eating frequency with 74 percent and 26 percent indicating that they very often or sometimes eat breakfast, respectively.

Reported breakfast eating differed significantly by gender and age; girls were less likely to report eating breakfast very often (67 percent) compared with boys (80 percent), and sixth-grade children were less likely to report eating breakfast very often (68 percent) compared with fourth-grade children (78 percent). More than half (60 percent) of the children perceived that eating breakfast provides benefits of increased energy and ability to pay attention in school. Common perceptions of barriers to eating breakfast were lack of time and not being hungry in the morning. Other factors, such as not having food at home, worrying about breakfast making them fat, or not wanting others to see them eat in the cafeteria were not important barriers for many children. Compared with boys, girls were more likely to report that they skip breakfast because it might make them fat. The authors conclude that, given the tendency to use skipping breakfast as a weight-related behavior by children and adolescents, and that food choice behaviors track into adulthood, it is important for nutrition educators to promote eating breakfast at home or school as a routine part of the day for all children.

- 37) Rogers PJ. “How Important is Breakfast?” *British Journal of Nutrition* 1997;78:197-198.**

This short commentary on articles from 1995 and 1997 relates associations between breakfast, diet and cognitive effects. The author concludes that increasing the consumption of breakfast is more likely than not to be beneficial, especially in populations where greater numbers of children are nutritionally at-risk.

- 38) Siega-Riz AM, Popkin BM, Carson T. “Trends in Breakfast Consumption for Children in the United States from 1965-1991. *American Journal of Clinical Nutrition*. 1998;67(suppl):748S-756S.**

The authors, University of North Carolina at Chapel Hill researchers conducting the study with support from the Kellogg Company, examined breakfast consumption patterns and trends by pooling samples from the Nationwide Food Consumption Surveys of 1965 and 1977-1978 and the 1989-

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1991 Continuing Survey of Food Intakes by Individuals. They found a significant decline in breakfast consumption between 1965 and 1991, for all age groups, but particularly for older adolescents 15-18 years old. The greatest decline was among adolescent girls, who dropped 19.7 percentage points from 84.4 percent in 1965 to 64.7 percent in 1991, meaning that less than two-thirds of girls aged 15-18 were eating breakfast by the 1990s.

39) Simeon DT, Grantham-McGregor S. “Effects of Missing Breakfast on the Cognitive Function of School Children of Differing Nutritional Status.”
American Journal of Clinical Nutrition 1989;49:646-53

The authors, researchers at the University of the West Indies, investigated the effect of missing breakfast on the cognitive functions of stunted children –those whose heights were below -2 standard deviations of the National Center for Health Statistics (NCHS) standards; previously severely malnourished children – who had been admitted to the University Hospital of the West Indies for severe malnutrition during the first two years of life; and nonstunted controls – whose heights were above -1 standard deviation of the NCHS standards.

Ninety students, divided into three groups of 30 were admitted to a special research ward where they ate dinner and at 8:00 a.m. the next day were randomly given a standard breakfast or a cup of tea representing no breakfast. Treatment was reversed the following day. At 11:00 a.m. they were given a battery of cognitive tests by testers blind to their breakfast status, including arithmetic – involving mental arithmetic problems and digit span (which involves the immediate recall of increasingly longer strings of digits read aloud); the coding subtest of the Wechsler Intelligence Scale for Children – in which children have to substitute symbols for numbers as quickly as possible; comprehension subtests of the Clinical Evaluation of Language Functions in fluency – involving naming as many items as possible in two different categories – and listening – in which short stories are read aloud and children answer questions about them; the Matching Familiar Figures Test (MFFT) – in which children are presented two cards and must identify which of the pictures on the second card is exactly like the one on the first card; and Hagen’s Central-Incidental task (HCI) – for which children look at various cards and then have to remember which objects or animals were on the cards.

The previously severely malnourished and the stunted groups behaved similarly when they missed breakfast and were combined and compared with the control group for tests. The children in this combined group scored significantly lower on tests of fluency, arithmetic, digit-span-backwards, and digit-span-forward and were less efficient in the matching figures tests when they had no breakfast. These tests correspond to generation of ideas and motivation, visual short-term memory, auditory short-term memory with an immediate processing component, and efficiency of problem solving. The children in the combined group were adversely affected in a number of cognitive functions when they missed breakfast, while the control group was not adversely affected in any of the cognitive tests when breakfast was omitted. Therefore, missing breakfast could be a serious contributor to poor school achievement in undernourished children.

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- 40) Taras H. “Nutrition and Student Performance at School.” *The Journal of School Health* 2005;75(6):199-213.**

This review of 18 articles describes effects on school-aged children of eating or not eating breakfast. Many studies find that children are more likely to attend school and be on time when a school breakfast program exists. Positive effects are consistently found among severely undernourished populations. Improved functions include verbal fluency, arithmetic, tests of attention, memory, creativity, physical endurance, and general tests of academic achievement and cognitive functioning.

- 41) Vaisman N, Voet H, Akivis A, Vakil E. “Effects of Breakfast Timing on the Cognitive Functions of Elementary School Students.” *Archives of Pediatric and Adolescent Medicine* 1996 150:1089-1092.**

The authors, researchers at Hebrew University, Jerusalem, and Bar Ilan University, Israel, study the effect of breakfast timing on selected cognitive functions of elementary school students. The researchers conducted a 2-week randomized control intervention trial for the 569 subjects, ages 11 to 13 years, from five elementary schools. Subjects also completed a questionnaire about food intake. There were two tests: 491 subjects completed test 1; 5033 subjects completed test 2; and 430 subjects completed both tests. Each subject who was tested twice took two versions of the Rey Auditory-Verbal Learning Test, logical memory subtest of the revised Wechsler Memory Scale, and the Benton Visual Retention Test. In the first test, subjects were tested in the second hour of school, between 8:55 and 9:35 a.m. After the first test, two thirds of the subjects started a 14 day program where they ate sugared cornflakes and milk every morning between 8:00 and 8:20 a.m. The other third were controls.

In the first test, on immediate recall, children who ate breakfast on the test day scored significantly higher than those who did not eat breakfast. In the second test, there were 322 subjects who ate breakfast and 181 control subjects. After 15 days, children who ate breakfast at school scored notably higher on most of the tests than did children who ate breakfast at home or did not eat breakfast. There were statistically significant differences between children who ate breakfast at school and those who ate at home or not at all, in best learning, mean learning, retroactive interference, delayed recall, recognition, temporal order, story and picture.

- 42) Wesnes KA, Pincock C, Richardson D, Helm G, Hails S. “Breakfast Reduces Declines in Attention and Memory over the Morning in Schoolchildren.” *Appetite* 2003;41(3):329-31.**

The authors, researchers at Cognitive Drug Research Ltd, DPRNutrition, Cereal Partners, and Reading Scientific Services Ltd, all in the United Kingdom, test the mental performance of 29 schoolchildren, 15 girls and 14 boys, following one of two cereal breakfasts, glucose drink or no breakfast, in a randomized, cross-over study. For five consecutive days, the children, aged 9-16, visit a laboratory where they complete computerized tests to assess attention, working

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memory and episodic memory through various word and picture presentation, recall and recognition tasks, in addition to others. They are randomly given one of the four breakfast options and complete the computerized tests four more times.

Two of the cognitive assessment factors – attention and episodic memory – showed significant changes with treatment. In six of the seven contributing measures for these two factors, participants declined in their performance significantly more after no breakfast or a glucose drink than if they had eaten cereal.

43) Wilson NC, Parnell WR, Wohlers M, Shirley P. “Eating Breakfast and its Impact on Children’s Daily Diet.” *Nutrition & Dietetics* 2006;63:15-20.

The authors, researchers at the University of Otago, New Zealand, describe the impact of eating breakfast on the nutrient intakes of 3,275 New Zealand children aged 5-14 years. Using the 2002 National Children’s Nutrition Survey (CNS02) in which nutrient intake and breakfast consumption were determined using 24-hour dietary recalls, children who consumed at least one item between 6 and 9 a.m. were considered breakfast eaters and all others were considered non-breakfast eaters. The New Zealand Index of Deprivation was used as an index of socioeconomic status. Weight status and BMI were determined from height and weight measurements. The statistical software package STATA was used for all data analyses.

In total, 84 percent of the children reported eating breakfast, though younger children were more likely to eat breakfast than older children. Breakfast eaters had significantly higher intakes of protein, dietary fiber, and folate than did non-breakfast eaters. Breakfast cereal was the most common breakfast choice (57 percent).

44) Wyon D, Abrahamsson L, Jartelius M, Fletcher R. “An Experimental Study of the Effects of Energy Intake at Breakfast on the Test Performance of 10 Year-Old Children in School.” *International Journal of Food Science and Nutrition* 1997;48(1):5-12.

The authors, researchers at the National Institute of Occupational Health, Copenhagen, Denmark, Uppsala University in Sweden, and the Kellogg Company of Great Britain, examined the effects of energy intake at breakfast on school performance in almost 200 10-year old students in ten classes at five different schools. Over the course of four days, each student was randomly provided with a low or high energy breakfast, meaning 832 kcal vs. 197 kcal for boys, and 567 kcal vs. 147 kcal for girls, each day, with all uneaten food returned. An interviewer, blind to breakfast type, obtained a 24-hour recall from each child. Performance assessments were administered to the students by teachers blind to the treatment condition. Eating a high energy breakfast was strongly associated with improved performance on the creativity test, addition and number checking, and voluntary endurance in the initial warm-up exercise. Energy intake at breakfast had no significant effect on energy intake at school lunch. Fewer children reported feeling badly, and self-estimates of hunger were lower after consuming a high energy breakfast.

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- 45) Zullig K, Ubbes VA, Pyle J, Valois RF. “Self-Reported Weight Perceptions, Dieting Behavior, and Breakfast Eating Among High School Adolescents.” *Journal of School Health* 2006;76(3):87-92.**

The authors, researchers at Miami University, Oxford, OH, and the University of South Carolina, Columbia, SC, explore the relationships between breakfast eating, weight perceptions, and dieting behavior in 4597 public high school adolescents in South Carolina using the Centers for Disease Control and Prevention Youth Risk Behavior Survey (YRBS). Schools were randomly selected and the students in the 71 schools chosen were each given a questionnaire in which they were asked about their breakfast habits over the previous five days. Results were obtained and analyzed for four race and gender groups: white females, black females, white males, and black males. The data were analyzed using SAS-callable Survey Data Analysis (SUDAAN), taking into account the weighting as well as the clustering within schools and classes nested within schools. The independent variables analyzed in this study were: self-perceptions of weight (overweight/underweight), current weight goal (trying to lose/gain weight), dieted to lose weight (past 30 days), took diet pills to lose weight (past 30 days), and vomited or took laxatives to lose weight (past 30 days).

Approximately 42 percent of the study sample reported not eating breakfast during the past five school days. More than half of the study participants reported perceptions of being overweight. For white females, there were significant associations between not eating breakfast and having self-perceptions of overweight, dieted to lose weight, fasted to lose weight, and vomited or took laxatives to lose weight. For black females, there was only a significant association between not eating breakfast and having fasted to lose weight. Among both white and black males, skipping breakfast was significantly associated with having self-perceptions as overweight, trying to lose weight, eating fewer calories to lose weight, fasted to lose weight, and took diet pills to lose weight. These results indicate that adolescents who engage in poor dietary practices with negative weight perceptions may be more likely to skip breakfast.