

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 the basic 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 the final model.

- 2) **Alaimo K, Olson CM, Frongillo EA Jr.** “Food Insufficiency and American School-Aged Children’s Cognitive, Academic and Psychosocial Development.” *Pediatrics* 2001;108(1):44-53.

The authors, researchers at Cornell University and the University of Michigan, examine associations between food insufficiency and cognitive, academic, and psychosocial outcomes for 3,286 children ages 6-11 and 2,063 teenagers ages 12-16 years in the United States using regression analyses of data from the Third National Health and Nutrition Examination Survey (NHANES III). They classify children as food-insufficient if the family reported sometimes not getting enough food to eat. They also look at a number of risk factors and academic and cognitive outcomes. Risk factors for teenagers include: an unemployed family head, an unmarried family head, a crowded dwelling (>1 person per room), moved 3 or more times, no health insurance, no regular source of health care, blood lead

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exposure (≥ 10), and no child care attendance. Risk factors for children include the above as well as birth weight below 2500 g, exposure to prenatal smoke, birth complications, and a mother under age 18 at child's birth. These risk factors were plotted by increasing number against academic and psychosocial outcomes.

Children, ages 6 to 11 with food-insufficiency had significantly lower arithmetic scores, and were more likely to have repeated a grade and to have seen a psychologist, after adjusting for confounding variables. Teenagers experiencing food-insufficiency were more than twice as likely to have seen a psychologist, almost 3 times as likely to have been suspended from school, almost twice as likely to have had difficulty getting along with other children, and 4 times as likely to have no friends. With increasing numbers of risk factors, children had increased odds of negative academic and psychosocial outcomes. For both children and teenagers Wechsler Intelligence Scale for Children (WISC) and Wide Range Achievement Test (WRAT) scores decreased with increasing numbers of risk factors. These results demonstrate that negative academic and psychosocial outcomes are associated with family-level food insufficiency.

- 3) Albertson AM, Andersonh 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 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.

- 4) Bartfeld J, Kim M, Ryu JH, Ahn H. "The School Breakfast Program Participation and Impacts." United States Department of Agriculture. Contractor and Cooperator Report No. 54. July 2009.**

The report analyzed determinants of participation in the School Breakfast Program (SBP) and benefits of participating in the program. First, the authors examined participation patterns in the SBP among third graders. Next, they investigated the impact of the SBP on food insecurity. Lastly, they analyzed the impact of the SBP and breakfast skipping.

In the first analysis, the authors used data from the Early Childhood Longitudinal Study Kindergarten (ECLS-K). The study found that school breakfast is less widely utilized than school lunch among their sample population. Higher breakfast participation was related to lower socioeconomic status.

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Students were also more likely to participate if breakfast was served in the classroom.

The second analysis also used data from the Early Childhood Longitudinal Study Kindergarten (ECLS-K), however the sample was limited to students below 185 percent of the federal poverty level. Participation rates were associated with region (south), location (rural areas), percent of low-income children in school, and median housing cost (more common in lower rent areas).

The final analysis concluded that breakfast availability in schools reduces the risk of breakfast skipping. Overall, the report indicates that the SBP enhances food security, particularly among families at the edge of food insecurity, and increases the likelihood that children, especially low income, eat breakfast at school.

- 5) **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 3 days out of 3 possible 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.

- 6) **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 improve following glucose ingestion while easy tasks are not affected. Glucose improves attention and reaction to frustration in children according to one study. The author

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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.

7) Bhattacharya J, Currie J, Haider S. “Breakfast of Champions? The School Breakfast Program and the Nutrition of Children and Families.” National Bureau of Economic Research. June 2004.

The authors examined the impact of the School Breakfast Program (SBP) and its availability using the National Health and Nutritional Examination Survey III (NHANES). The main measurement of this study was the Healthy Eating Index (HEI), which is comprised of 10 components: grains, vegetables, fruits, milk, meat, total fat, saturated fat, cholesterol, sodium, and variety. The study also examined the intake of fiber, sodium, potassium, magnesium, zinc, iron, calcium, total calories, and the percentage of total calories from fat and saturated fat. Lastly, the study examined Vitamin A, C, and E, and folate, anemia, and high cholesterol. Sample participants were 5 to 16 years old (n= 4,841) who were attending school or on vacation from school. They completed a dietary questionnaire and had a physical exam.

The study concluded that the SBP enhances the scores on the HEI and decreases calories from fat. In addition, the SBP reduces the probability of low intakes of fiber, serum Vitamin C, E and folate, as well as iron and potassium. Lastly, SBP improves the quality of the diet among children and their families, which is likely to improve health and well-being in the future.

8) Boutelle K, Neumark-Sztainer D, Story M, Resnick M. “Weight control behaviors among obese, overweight, and nonoverweight adolescents.” *J Pediatr Psychol.* 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.

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- 9) **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, 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. 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.

- 10) **Brown JL, Beardslee WH, Prothrow-Stith D. “Impact of School Breakfast on Children’s Health and Learning.” Sodexo Foundation. November 2008.**

The authors provide a review of the literature on the School Breakfast Program (SBP). Drawing from more than 100 published research articles, the authors conclude that the SBP improves attendance, tardiness, concentration, alertness, energy, comprehension, learning, memory, standardized test scores (math and readings), and overall academic performance. The SBP also improves

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nutritional status and reduces illnesses. Lastly, the SBP has been shown to enhance psychosocial well-being and decrease aggressive behavior.

- 11) Burghardt J, Devaney B. *The School Nutrition Dietary Assessment Study: Summary of Findings*. Princeton, NJ: Mathematica Policy Research, Inc; 1993.**

This report describes the National School Lunch Program (NSLP) and School Breakfast Program (SBP), presents findings on the nutrients and foods provided in school meals, and describes the dietary intakes of the nation's students on a typical school day. For the study, information was collected from approximately 3,350 students in grades 1-12 in 545 schools nationwide. Information was collected on (1) SBP participation and characteristics of food service operations, and (2) all foods and beverages offered as part of the SBP during a one-week period from February to May 1992. The study finds that the SBP is available to slightly more than half of the nation's students, since more than half of all schools participate in the School Breakfast Program. Close to 20 percent of those to whom it is available participate, and that school breakfasts provide one-fourth of the Recommended Dietary Allowance for most nutrients other than calories and zinc.

- 12) Center on Hunger, Poverty and Nutrition Policy. "Statement on The Link Between Nutrition and Cognitive Development in Children." Center on Hunger, Poverty and Nutrition Policy, Tufts University, Medford, MA, 1998.**

This is an advocacy piece that presents the latest research (as of 1998) on nutrition and cognitive development, explains the importance of federal nutrition programs for children, and highlights corporate support for addressing nutritional deficiencies among American children. In an overview of recent research findings, scientific references are provided in addition to a discussion of the potential impact of child nutrition programs improving nutritional status and cognition. Some significant findings, for which the authors present research evidence, are: (1) Under-nutrition along with environmental factors associated with poverty can permanently retard physical growth, brain development and cognitive functioning; (2) Poor children who attend school hungry perform significantly below non-hungry low-income children on standardized tests; and (3) Improved nutrition and environmental conditions can modify the effects of early under-nutrition. Short descriptions are given of key federal nutrition programs relating to children. There are also statements from corporate leaders both testifying before the House Budget Committee in support of a special food program for low-income children, and in support of the Mickey Leland Childhood Hunger Relief Act to address hunger among American children.

- 13) 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." *Can J 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

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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 ≥ 3 times/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.

14) Condon EM, Crepinsek MK, Fox MK. "School Meals: Types of Foods Offered to and Consumed by Children at Lunch and Breakfast." *Journal of American Dietetic Association* 2009; 109(2): s67-s78.

The authors, researchers at Mathematica Policy Research Inc., used data from the third School Nutrition Dietary Assessment Study to describe the type of food offered in school lunch and breakfast, types of food consumed at lunch and breakfast during school days, and the differences in food consumption between those who did and did not participate in the school meal programs. The sample included 130 school food authorities, 388 schools and 2,314 children grades 1 through 12.

In each school, the food service manager completed a menu survey, which included foods and beverages offered with detailed descriptions of each item (e.g. name, preparation, content, manufacturer information). In addition, an in-person 24-hour dietary recall was performed, which included types and quantities of food and beverages consumed, eating occasions (i.e. breakfast, lunch, dinner, snack), time of day, and location of food purchased. Both the school survey menu and 24-hour dietary recall were coded using SurveyNet (version 3.14), USDA's computer assisted food-coding and nutrient analysis system. A food grouping analysis was used to describe the types and amounts of food offered and consumed in school meals by children in the 24-hour recall. The study's findings suggested school meals offer a selection of healthy food items from key food groups during breakfast and lunch. The study found a positive association between National School Lunch and Breakfast Program participation and milk, fruit, 100 percent juice, and vegetable consumption compared to non-participants.

15) 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 (SBP) to

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the Universally-Free School Breakfast Program (UF), entitled “Operation Breakfast,” had an effect on SBP 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 obtain data from interviews, school attendance and tardiness records, and nutrient content of breakfasts.

They find that participation in SBP increased nearly 60 percent among Central Falls students compared to the control group after the UF breakfast 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 UF-SBP.

16) Crepinsek MK, Gordon AR, McKinney PM, Condon EM, Wilson A. “Meals Offered and Served in US Public Schools: Do They Meet Nutrient Standards?” *Journal of American Dietetic Association* 2009; 109(2): s31-s43.

The authors investigated the energy and nutrient composition, portion of school meals meeting the School Meals Initiative for Healthy Children (SMI), and major food sources of energy and key nutrients of school meals. The data was collected as part of the third School Nutrition Dietary Assessment Study. The sample included 130 school food authorities, 388 schools, and 2,314 children grades 1 through 12 during the 2004-2005 academic school year.

In each school, the food service manager completed a menu survey, which included descriptions, portion size, manufacturer/brand, or recipe of food offered, and the size of portions selected by children. Menu data was coded using SurveyNet (version 3.14), USDA’s computer assisted food-coding and nutrient analysis system. To estimate nutrient and energy content of school meals, the researcher used both unweighted and weighted analyses. The unweighted analysis estimated the average nutrient content of meals offered. The weighted analysis assessed the average nutrients in meals served. SMI nutrient standards were determined by comparing the average energy and nutrient content of school menus to all SMI standards. Lastly, major food sources of nutrients were identified broadly by grouping menu items in one of nine major food groups.

About three fourths of all schools’ lunch menus met the minimum SMI requirements for food energy and about 85 percent met the SMI standards for protein, vitamins (i.e. A and C), and minerals (i.e. calcium and iron). Consistent with the program’s goal, the school breakfast program provided lower levels of food energy, nutrients, and less energy from fat. Also, more than 90 percent of schools surveyed met the SMI standards for key nutrients for school breakfast.

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- 17) Crepinsek MK, Singh A, Bernstein LS, McLaughlin JE. “Dietary Effects of Universal-Free School Breakfast: Finding from the Evaluation of the School Breakfast Program Pilot Project.” *Journal American Dietetic Association* 2006; 106(11):1796-1803.**

The authors examined the effects of universal free school breakfast on participation and dietary outcomes of elementary school children. The pilot program was implemented during the 2000-2001 and 2002-2003 school years with 79 treatment and 74 control schools. Students grades 2 through 6 were selected to participate (n= 4, 358). The treatment was offering universal free breakfast to all students. In the treatment group, 18 of 79 schools ate breakfast in the classroom. In the spring of 2001, one 24-hour dietary recall was collected and analyzed using the Nutrition Data System for Research software (version 4.03), which analyzed mean food energy and nutrient intake.

In the treatment schools, breakfast participation increased 18 percentage points more than the control group. In addition, students in treatment schools were more likely to consume a nutritionally substantive breakfast compared to the control. Also, the treatment school students consumed more calcium, magnesium, and phosphorous and less cholesterol. Lastly, universal free breakfast consumers had significantly lower mean energy intakes than controls.

- 18) 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 has a short-term effect in improving selected learning skills, especially work memory. School breakfast programs have a positive effect on the nutritional status of children, on school attendance and most likely, dropout rates, according to studies conducted in Jamaica, Peru and the United States – Baltimore and Philadelphia. However, it is not enough that students have a better nutritional status and they attend school. Apparently all students having school breakfast are in a better condition to perform at school, but whether this benefit can definitely be obtained depends on the school environment (well-illuminated, aired rooms; enough space; adequate teaching; etc.) The effect of breakfast consumption on school performance depends on the interaction between the program, student characteristics, and school organization. Unless the school setting guarantees a minimum quality standard, the benefits of breakfast consumption will not be evident in performance in complex areas like language or math.

- 19) Deshmukh-Taskar PR, Nicklas, TA, O’Neil CE, Keast DR, Radcliffe JD, Cho S. “The Relationship of Breakfast Skipping and Type of Breakfast Consumption with Nutrient Intake and Weight Status in Children and Adolescents: The National Health and Nutrition Examination Survey 1999-2006.” *Journal of the American Dietetic Association* 2010; 110(6): 869-878.**

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The authors examined the relationship between breakfast skipping and type of breakfast consumption by nutrient intake, nutrient adequacy, and weight circumference for U.S. children aged 9 to 13 years (n=4,320) and adolescents aged 14 to 18 years (n=5339). They used data from the National Health and Nutrition Examination Survey 1999-2006, which included a 24-hour self-reported dietary recall to assess total energy, total and percent energy from macronutrients, and micronutrients intakes. To calculate adequate values, they used mean adequacy ratio (MAR) for micronutrients and anthropometric measurements. To compare breakfast skippers, ready-to-eat (RTE) cereal consumers, and other breakfast consumers (other breakfast), the authors used Bonferroni's correction for multiple comparisons.

Breakfast skipping was highest among adolescent girls and children/adolescents from single-parents or low-income households. It was lowest among Mexican-American/Hispanic children. The intake of added sugars was highest among breakfast skippers compared to other breakfast and RTE consumers. RTE consumers had the best nutrient intakes with lower intakes of total fat and cholesterol and higher intakes of total carbohydrates, dietary fiber, and micronutrients. Breakfast skippers had higher waist circumference compared to RTE consumers. In addition, breakfast skippers had a higher prevalence of obesity compared to RTE and other breakfast consumers.

20) 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.

21) Gleason PM, Dodd AH. "School Breakfast Program but Not School Lunch Program Participation Is Associated with Lower Body Mass Index." *Journal of American Dietetic Association* 2008; 109(2): s118-s128.

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The authors, researchers at Mathematica Policy Research Inc., examined the relationship between school meal programs on children's weight status, including BMI and likelihood of being overweight or obese. They used data from the third School Nutrition Dietary Assessment Study of student (n= 2,314) in grades 1 through 12. A 24-hour in-person dietary recall was conducted, along with student and parent interviews, and height and weight measurements of each student. A multivariate regression model was used to estimate the relationship between weight status and school meals.

In this study, about 40 percent of children in all grade levels were classified as overweight or obese. On average 70 percent of students participated in school lunch and 26 percent participated in school breakfast during a typical week. This study found no evidence that school meals contribute to childhood obesity. School breakfast participation was associated with a reduced mean BMI level; therefore, school breakfast may be a protective factor against childhood obesity.

22) Gleason P, Suitor 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 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 6 to 18 that 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 for participants compared to 3.8 servings a day for nonparticipants. 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.

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- 23) 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.**

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 1 week. Two weeks later the treatment was reversed for 1 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 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.

- 24) 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 3 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.

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- 25) 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 show 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. 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.

- 26) 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 of being at risk of overweight if they participated in school lunch and breakfast programs. Food insecure girls who participated in school lunch, breakfast and food stamps, had a 68 percent reduced odds of being at risk of overweight.

- 27) 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

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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 1 week before and 1 week 6 months after implementation of USBP. 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.

28) Kleinman RE, Murphy JM, Little M, Pagano M, Wehler CA, Regal K, Jellinek MS. "Hunger in Children in the United States: Potential Behavioral and Emotional Correlates." *Pediatrics* 1998;101(1):E3.

The authors, researchers at Massachusetts General Hospital, Harvard Medical School, CAW and Associates, and Just Harvest: A Center for Action Against Hunger, examine the relationship between hunger as defined by the Community Childhood Hunger Identification Project (CCHIP) measure and variables reflecting the psychosocial functioning of low-income, school-aged children. Hunger status is defined by CCHIP as "hungry", "at-risk for hunger" or "not hungry," for the sample of 328 parents and children from a CCHIP study of families with at least one child under 12 years old, incomes at or below 185 percent of the poverty level living in Pittsburgh and the surrounding area.

Parents complete the Pediatric Symptom Checklist (PSC), a brief parent-report questionnaire, to assess their children's emotional and behavioral symptoms. Children defined as "hungry" according to CCHIP were significantly more likely to have clinical levels of psychosocial dysfunction on the PSC than "at-risk" or "not hungry" children.

Results also suggest that behavioral, emotional and academic problems are more prevalent in hungry children, with anxiety having the strongest association with hunger. These hungry children were two to four times more likely to have repeated a grade, received special education services, or received mental health counseling than other low-income children whose parents did not report hunger.

The central finding of this study is that children for whom a parent reported child hunger were two to seven times more likely to report psychosocial problems on the PSC and on other measures of academic functioning than "at-risk for hunger" or "not hungry" children.

29) 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 children's cognition. Subjects received either oatmeal, ready-to-eat cereal or no breakfast 1 day a week for 4 weeks after filling out a mini-questionnaire. Their parents were instructed not to feed the children after 10:00 p.m. the night before

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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.

30) 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. October 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. 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 were impacts discovered from a Pediatric Symptom Checklist (PSC). There were no significant effects in attendance or tardiness rates; however, attendance levels

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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.

31) 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, Mass, public schools, the SBP 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 grades 3 through 6 were considered eligible if for the study 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 SBP participants.

Increases in CTBS total scores after implementation of SBP are significantly greater for SBP participants. Tardiness rates decreased significantly for participants and increased for nonparticipants. Absence rates are significantly lower for SBP participants after implementation of the School Breakfast Program. The authors find that participation in SBP by low-income children has a significant association with improvement in standardized achievement test scores and rates of absence and tardiness.

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- 32) Miller G, Forgac T, Cline T, McBean L. “Breakfast benefits children in the US and abroad.” *Journal American College Nutrition* 1998;17:4-6.**

This editorial briefly gives a recap 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. On the other hand, 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 toward improving their nutrient status and academic performance.

- 33) Millimet DL, Tchernis R, Husain. “School Nutrition Programs and the Incidence of Childhood Obesity.” *The Journal of Human Resources* 2009; 45(3):640-654.**

The authors investigated the relationship between school breakfast and school lunch participation and weight status of primary school students from kindergarten through third grade (n= 13,531). They used data from the Early Childhood Longitudinal Study Kindergarten Class of 1998-99 (ECLS-K) to analyze health status and participation rates in the school meal programs. To measure health status, the authors evaluated the child’s age, gender, weight, and height. Body mass index (BMI), growth rate in BMI, change in BMI percentile, and indicators for overweight and obesity status were also measured.

Using the panel data, the authors concluded that school breakfast participation is correlated with lower weight, however, the correlation is weaker for school lunch participation. The authors also found that school breakfast participation has a negative effect on child weight status, thus, acting as a protective factor against childhood obesity.

- 34) Morris CT, Courtney A, Bryant CA, McDermott RJ. “Grab ‘N’ Go Breakfast at School: Observation from a Pilot Program.” *Journal of Nutrition Education and Behavior* 2010 42(3): 208-209.**

The authors conducted a two week “Grab ‘N’ Go” pilot study, in an effort to increase school breakfast participation. The evaluation of the study included 8 post-program focus groups, interviews with the school principal, nutrition staff, and custodian, and surveys to students ages 9 to 13 years old (n=209) and teachers (n= 42). The primary motivator for students to eat breakfast was the taste and location of food served. The Grab ‘N’ Go school breakfast program reached students who normally skipped breakfast. Teachers surveyed found no inconvenience and reported that students seemed more attentive.

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- 35) Murphy JM. “Breakfast and Learning: An Updated Review.” *Journal of Current Nutrition and Food Science* 2007; 3(1): 3-36.**

The author presents an extensive review of the school breakfast program (SBP) and its benefits prior to 1999. The author also provides an overview of the SBP from 1999 to 2004, which analyzes the impact of school breakfast on nutrition, student academic, cognitive, behavioral, and health outcomes. Lastly, the author examines the School Breakfast Program Pilot Project (SBPP).

Of the articles reviewed, children participating in SBP were less likely to have lower serum levels of Vitamin C and E, folate, and iron. The availability of SBP did not increase the percentage of calories from fat and total calories. School breakfast consumption was significantly associated with improved student attention, standardized test scores, attendance, tardiness, and mood. Also, teachers were less likely to report hunger if students participated in the SBP and more likely to report improved learning and behavior. Lastly, breakfast skipping was found to increase the risk of being overweight and negatively affected cognitive learning, memory, and attention.

The SBPP project purpose was to increase breakfast eating and improve educational outcomes. All children ate school breakfast for free, in contrast to the current SBP approach, regardless of family income. This study found that breakfast skippers were significantly less likely to consume adequate amounts of grains, fruits, and vegetables. The study also found that consuming school breakfast had a positive impact on students’ standardized test scores, attendance rate, and tardiness. The overall review concludes that breakfast eating has a positive impact on students’ academic and health outcomes.

- 36) 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, 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 find that hungry and at-risk for hunger children are absent, late, hyperactive and have behavioral and attention problems more often than non-hungry children

- 37) 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

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Baltimore Public Schools, conduct interviews and collect school breakfast participation and school records information before and 4 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 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, they find 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.

38) 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 included 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 were 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 showed significantly larger increases in standardized test scores than control schools.

39) 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.

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.

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The relationship between breakfast program status and standardized test scores (Maryland State Pupil Assessment Project (MSPAP) scores), School Performance Index (SPI) scores, and attendance were assessed.

Data was analyzed using Oneway and Multiple 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.

Schools that provided breakfast without charge for 3 years improved significantly more in attendance than both comparison schools and schools that participated in the program for two years.

40) 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 serve breakfast to all students at no charge, regardless of income, and students consume 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 was collected on breakfast program participation rates, absence rates, tardy 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, though 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

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program resulted in decreased hunger and improvements in factors critical to student learning such as lower tardiness and disciplinary referral rates.

- 41) 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 was 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.

- 42) 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 further minimize intersubject variability by exposing the same subjects to both breakfast and fasting periods. The other studies they examine employ a quasi-experimental 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 to 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

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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 breakfast 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. (47)) 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. (44))

43) 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 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 group for experiment 1 and to the reverse for experiment 2. The American children completed the Matching Familiar Figures Test (MFFT) and the Hagen Central Incidental Test (HCIT). Three paper and pencil tests: number discrimination, PPVT, and the Raven Progressive Matrices, and three computerized tests: Simple Reaction Time, Stimulus Discrimination (SDT), and Sternberg Memory Search Test (SMST), 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.

44) 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.

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- 45) 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.

- 46) 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.” *J Nutr Educ Behav.* 2002;34:47-52.**

The authors, researchers at the University of Minnesota, use a teacher-administered survey at the end of a 3-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, 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. Girls were more likely to report that they skip breakfast because it might make them fat compared with boys. 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

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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.

- 47) 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.

- 48) 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 1989-1991 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.

- 49) 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.

- 50) 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 and in the study 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

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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.

- 51) 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 5 consecutive days, the children, aged 9-16, visit a laboratory where they complete computerized tests to assess attention, working 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 4 more times.

Two of the cognitive assessment factors – attention and episodic memory – showed significant changes with treatment. In 6 of the 7 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.

- 52) 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 Children in 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

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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).

- 53) 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 10 classes at 5 different schools. Over the course of 4 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 bad and self-estimates of hunger were lower after consuming a high energy breakfast.

- 54) 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 5 days. Results were obtained and analyzed for 4 race and gender groups: white females, black females, white males, and black males. The data was 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 5 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

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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.