

COMMENTARY
FOR THE JOURNAL OF CHILD NUTRITION & MANAGEMENT

THE LINK BETWEEN CHILD NUTRITION AND
LEARNING IN SCHOOL FOOD SERVICES

Dr. Fred J. DeMicco
School of Hotel, Restaurant and Recreation Management
The Pennsylvania State University
201 Mateer Building
University Park, PA 16802
(814) 863-4847

and

Jeannie Sneed, PhD, RD
Department of Nutrition & Food Management
Oregon State University
108 Milam Hall
Corvallis, OR 97331-5103
(541) 737-5098
Jeannie.Sneed@orst.edu

The authors acknowledge and thank Dr. Martha Conklin of NFSMI at the University of Mississippi for review of this manuscript.

Commentary

The Link Between Child Nutrition and Learning in School Food Services

Overview

Sound scientific evidence suggests a strong link between child nutrition and learning. Overwhelmingly this supports the importance of the availability of school food service programs in improving the educational performance of our nation's children. Future U.S. prosperity through the development of "brain power" hinges on a sound underpinning of nutrition fundamentals in school children through education and practices in the school food service operations.

Our nation stands at an auspicious moment. With poverty now victimizing nearly one in four U.S. children, top leaders must make a commitment to invest in people to preserve our nation's economic and moral strength. While language like "investing in children" may be new, increasing numbers of corporate CEO's, for example, note the strong link between our nation's future and the health and well-being of our children. Protecting children's health and cognitive development may be the best way to build a strong America (Tufts University, 1998).

The following review of the literature illustrates the link between child nutrition and learning. These research findings can be used to support the critical role child nutrition programs play in providing children with the tools it takes to learn. These statements can be used in the development of nutrition policy and for the promotion of accessibility to child nutrition programs for all children.

Child Nutrition and Cognitive Development and Performance

This is a summary in bulleted outline form that reviews the scientific findings and supporting facts for the link between nutrition and learning and the role of the school breakfast and lunch programs.

- Severe malnutrition has been associated with intellectual dysfunction in young children (Latham & Cobos, 1971; Pollitt & Thompson, 1977; Rosenthal & Goodwin, 1985; Gabr, 1987). Inadequately nourished children have been characterized as apathetic, non-responsive, inactive, and irritable and these children have difficulty tolerating frustration and stress (Barrett, 1986; Gabr, 1987).
- Under-nutrition impacts the behavior of children, their school performance, and their overall cognitive development (Tufts University, 1998).
- Under-nutrition harms children silently. Even before it is severe and its results are readily detectable, inadequate food intake limits the ability of children to learn (Tufts University, 1998).
- Undernourished children decrease their activity levels and become more apathetic, affecting their social interactions, inquisitiveness, and overall cognitive functioning

(Tufts University, 1998).

- Evidence suggests that under-nutrition costs far more than the diminished well-being of youngsters during childhood. By robbing children of their natural human potential, under-nutrition results in lost knowledge, brain power, and productivity for the nation (Tufts University, 1998).
- Undernourished children also are more susceptible to illness and therefore more likely to be absent from school. Children who attend school hungry have diminished attention spans and are unable to perform tasks as well as their nourished peers. In these cases, the full value of the education provided is lost (Tufts University, 1998).
- Researchers at Harvard Medical/Massachusetts General Hospital in Boston found that hungry children are more likely to have behavioral and academic problems than children who get enough to eat. At school, hungry children had more problems with irritability, anxiety and aggression, as well as more absences and tardiness (Runyon, 1998; Murphy, 1998).
- Problems associated with learning may be related to hypoglycemia, or low blood sugar (Joos & Pollitt, 1987).
- Iron nutriture is related to cognitive performance and behavior, particularly with shorter attention spans, lower intelligence scores, and perceptual disturbance (Beard, Connor, & Jones, 1993). Research indicates a strong relationship between iron status and brain function (Tucker, Sandstead, Penland, Dawson, & Milne, 1984).
- Short attention span and poor educational achievement have been linked with iron deficiency anemia of pre-school and school-aged children (Buzina et al., 1989; Pollitt, Saco-Pollitt, Leibel, & Viteri, 1986; Pollitt, 1991). Improving the iron status of iron-deficient anemic children results in improved scores on achievement tests (Soemantri, Pollitt, & Akim, 1985; Pollitt et al., 1986).
- Recent research shows that iron deficiency anemia has an adverse effect on a child's ability to learn by influencing attention span and memory. This pervasive deficiency is now known to have a severe impact on cognitive development (Tufts University, 1998).
- Poor children who attend school hungry perform significantly below non-hungry low income peers on standardized test scores (Tufts University, 1998).

Research Supporting the National School Lunch and School Breakfast Programs (USDA)

- Supplemental feeding programs can help to offset threats posed to the child's capacity to learn and perform in school which result from inadequate nutrient intake (Tufts University, 1998).
- Research suggests that the availability of feeding programs in public schools throughout the academic year increases the probability that children will eat breakfast and improve their educational status (Pollitt, 1995).

- Consumption of breakfast (milk, cereal with sugar, egg, juice, and toast; energy and nutrient information not reported) also improved performance in a vigilance task (Continuous Performance Test). These psychophysiologic responses are generally associated with improved vigilance and attention (Conners and Blouin, 1982/1983).
- Consumption of breakfast consistently benefited the cognitive performance of undernourished children, particularly in working memory tests. Performance in the verbal fluency test was enhanced in the two Jamaican studies as was vocabulary in the Peruvian field study (Pollitt, 1995).
- A strong evaluation of the U.S. school breakfast program was conducted by Meyers et al. (1989) in Lawrence, Massachusetts. The school breakfast program was implemented in late January, before the start of the second semester of the 1986-87 school year. The improvements from 1986 to 1987 were significantly greater for participants than for non-participants in the total score of the Comprehensive Test of Basic Skills and in the language sub-score. Tardiness rates decreased for participants and increased for non-participants. The program effects were clearest among boys and Hispanics.
- The Myers et al. (1989) study published in the *American Journal of Diseases of Children* found that "participation in the school breakfast program is associated with significant improvements in academic functioning among low-income elementary school children."
- Studies in Jamaica and Peru confirmed what is generally believed to be an advantage of school feeding programs: they increase the attendance rate of children. In addition, the study in Peru suggested that the benefits of breakfast are particularly noticeable among nutritionally at-risk children (Pollitt, 1995).
- Martin (1979) found that fourth-grade children in Georgia performed better on achievement tests if they obtained adequate calories at breakfast, which generally related to overall calorie intake for the day and a more adequate total intake.
- Evidence suggests that working memory in well-nourished children is sensitive to the effects of an overnight and morning fast. If this suggestion were to be confirmed, it would have strong implications for the role of nutrition intervention in school settings-not only for developing societies but also for the industrialized world. In other words, the omission of breakfast would make a difference in the educational process (Pollitt, 1995).
- A 1997 State of Minnesota Breakfast Study found that students who ate breakfast before starting school had a general increase in math grades and reading scores, increased student attention, reduced nurse visits, and improved student behaviors.
- Research suggests that highly prevalent nutrient deficiencies (e.g., iron deficiency anemia) affect cognition, and that they can be prevented or remediated by a school breakfast program (Pollitt, 1995).
- A survey of third, fifth, and eighth grade children in Pennsylvania showed that frequency of eating breakfast was positively related to performance on reading and

math questions on a standardized test (Birkenshaw, 1991).

- A study conducted in the United States with children 9 to 11 years of age showed that fasting had a negative impact on accuracy in problem solving. For children with IQ scores below the median, the number of errors increased when no breakfast was eaten (Pollitt, Leibel, & Greenfield, 1981).
- Meyers, et al. examined the effect of the school breakfast program on school performance of low-income elementary school children in Lawrence, Massachusetts. Children who participated in the school breakfast program were shown to have significantly higher standardized achievement test scores than eligible non-participants. Children getting school breakfast also had significantly reduced absence and tardiness rates (Tufts University, 1998).
- Research findings show that participation in the school breakfast program is associated with significant improvements in academic functioning among low-income elementary school children. The research attributes the academic improvements to the effects of a morning meal and to the longer-term benefit of an improved dietary intake (Tufts University, 1998).
- Research indicates that routinely eating breakfast two hours prior to being tested does not improve cognitive functions in 11 to 13 year old elementary school students, but food supplementation 30 minutes prior to taking a test notably improves scoring. Further studies on the relationship between meal content, feeding time, and scholastic performance are needed (*Arch. Pediatr. Adolesc. Med.*, 1996).
- USDA research shows that children who participate in school lunch have superior nutritional intake compared to those who do not. Studies also show that low-income children depend on the school lunch program for one-third to one-half of their nutritional intake each day. These findings indicate that this program is highly significant insofar as protecting the nutritional status of most participating low-income children (Tufts University, 1998).

Conclusion

Recently Minnesota Governor Jesse Ventura (I) proposed allocating 70% of new state spending to education programs. According to a January 29, 1999, article in the *Minneapolis Star Tribune* Ventura's budget "seeks to lift student performance by reducing student to teacher ratios in kindergarten through third grade and by expanding breakfast programs to more than one third of elementary schools." The \$6 million school breakfast expansion would go into the "Fast Break to Learning" program, which is currently a pilot.

We now have evidence that even moderate under-nutrition, the type seen most frequently in the United States, can have lasting effects on the cognitive development of children. Inadequate nutrition is a major cause of impaired cognitive development, and is associated with increased educational failure among impoverished children (E. Pollitt, 1998).

School nutrition programs provide the foundation and commitment to strengthen our children's long-term health and wellness and our country's economic prosperity for the future.

It is clear to business people that if we fail to nurture and educate all of our children, we will close the doors of the future to the growing number of young people, who, today, are excluded from the mainstream of our society.

Dr. James J. Renier
Chairman and CEO
Honeywell, Inc.
In Tufts University, 1998

References

- Barrett, D. E. (1986). Behavior as an outcome in nutrition research. *Nutrition Reviews/Supplement*, pp. 224-236.
- Beard, J. L., Connor, J.R., & Jones, B.C. (1993). Iron in the brain. *Nutrition Reviews*, 51, 157-170.
- Birkenshaw, P. (1991). School breakfast: A healthy start for better learning. *Pennsylvania School Boards Association Bulletin*, pp. 29-30.
- Buzina, R., Bates, C.J., van der Beek, J., Brubacher, G., Chandra, R.K., Halberg, L., Hesecker, J., Mertz, W., Pietrzik, K., Pollitt, E., Pradilla, A., Suboticaneec, K., Sandstead, H.H., Schalch, W., Spurr, G. B., & Westenhofer, J. (1989). Workshop on functional significance of mild-to-moderate malnutrition. *American Journal of Clinical Nutrition*, 50, 172-176.
- Center for Applied Research and Educational Improvement. (1997, February). Energizing the classroom. Minneapolis, MN: Author.
- Conners, C. K., & Blouin, A.G.. (1982-1983). Nutritional effects on behavior of children. *Journal of Psychiatric Research*, 17, 193-201.
- Food and Consumer Services. (1997, December). Time for school breakfast: The research. Washington, DC: United States Department of Agriculture.
- Gabr, M. (1987). Under-nutrition and quality of life. *World Review of Nutrition and Dietetics*, 49, 1-21.
- Joos, S. K., & Pollitt, E. (1987). Nutritional status and behavior. In *Pediatric Nutrition: Theory and Practice*. R. J. Grand, J. L. Sutphen, and W. H. Dietz (eds.). Boston: Butterworth.
- Latham, M. C., & Cobos, F. (1971). The effects of malnutrition in intellectual development and learning. *American Journal of Public Health*, 7, 1307-1324.
- Martin, M. J. (1979). The examination of relationships between an adequate breakfast, the daily nutritional intake, pupil behavior, attendance, and achievement of selected fourth grade pupils of The Atlanta Public School System. Doctoral dissertation. Atlanta, Ga.: Georgia State University.
- Meyers, A. F. (1989). Under-nutrition, hunger, and learning in children. *Nutrition News*, 52(2), 5-7.
- Meyers, A. F., Sampson, A.E., Weitzman, M., Rogers, B.L., & Kayne, H. (1989).

School breakfast program and school performance. *American Journal of Diseases of Children*, 143, 1234-1239.

Murphy, M. J. (1998). Relationship between hunger and psychosocial functioning in low-income American Children. *Journal of the American Academy of Child and Adolescent Psychology*, 37(2), 163-170.

Pollitt, E., & Thompson, C. (1977). Protein-calorie malnutrition and behavior. In *Nutrition and the Brain*, vol. 2. R. J. Wurtman and J. J. Wurtman (eds). New York: Raven.

Pollitt, E., Leibel, R.L., & Greenfield, D. (1981). Brief fasting, stress, and cognition in children. *The American Journal of Clinical Nutrition*, 34, 1526-1533.

Pollitt, E., Saco-Pollitt, C., Leibel, R.L., & Viteri, F.E. (1986). Iron deficiency and behavioral development in infants and preschool children. *American Journal of Clinical Nutrition*, 43, 555-565.

Pollitt, E. (1991). Effects of a diet deficient in iron on the growth and development of preschool and school age children. *Food and Nutrition Bulletin*, 13(2), 110-118.

Pollitt, E. (1995). Does breakfast make a difference in school? *The Journal of the American Dietetic Association*, 95, 1134-1139.

Rosenthal, M.J., & Goodwin, J. S. (1985). *Cognitive Effects of Nutrition Deficiency*. New York: Plenum Press.

Runyon, K. D. (1998). Children who prosper in unfavorable environments: the relationship to social capital. *Pediatrics* 101(1), 12-18.

Soemantri, A. G., Pollitt, E., & I. Kim, I. (1985). Iron deficiency anemia and educational achievement. *The American Journal of Clinical Nutrition*, 42, 1221-1228.

Tucker, D. M., Sandstead, H.H., Penland, J.G., Dawson, S.L., & Milne, D.B. (1984). Iron status and brain function: Serum ferritin levels associated with asymmetries of corical electrophysiology and cognitive performance. *American Journal of Clinical Nutrition*, 39, 105-113.

Tufts University. (1998). The link between nutrition and the cognitive development in children. School of Nutrition Science and Policy, Center on Hunger, Poverty, and Nutrition Policy.

Valsman, N., Voet, H., Akivis, A., & Vakil, E. (1996). Effect of breakfast timing on the cognitive functions of elementary school students. *Archives of Pediatric Adolescent Medicine*, 150.