School Meals

a nutritional and environmental perspective

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ABSTRACT In light of the rise in childhood obesity rates and the influence of the food system on fossil fuel use, this article analyzes current school meals in Baltimore and makes suggestions for school meal reform based on both childhood nutrition and environmental resource use. The nutrient content and estimated energy costs of a typical school lunch are compared with a proposed alternate meal. The study indicates that healthier meals can significantly limit fossil fuel energy inputs for harvesting, production, processing, packaging, and transportation. The authors also provide strategies for developing menus that are both more nutritious and more energy efficient.

The rise in rates of obesity among all age groups and the health implications of this development have been well documented. However, the environmental impact of current dietary patterns has been less frequently considered. This article focuses on how school meals impact both child nutrition and environmental resource use. As many students receive one or two meals every day at school, school meal programs are a logical site for study and intervention. This paper examines the nutritional and environmental impacts of traditional

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school meals and presents strategies that prioritize children's health and efficient energy use.

Childhood Obesity

The increase in obesity among children and adolescents is one of the major public health challenges of our generation. The rate of childhood obesity in the United States has more than doubled over the past two decades (IOM 2004). Childhood obesity is of grave concern, since not only does the condition often continue into adulthood, but it is often a gateway condition for a host of chronic, diet-related diseases, such as heart disease, type 2 diabetes, stroke, hypertension, osteoarthritis, and some types of cancer. Diabetes and its co-morbidities are of particular concern for the obese. A recent CDC study estimated that one in three children born in 2000 will develop diabetes in their lifetime (Narayan et al. 2006). While many children may not develop the symptoms of diabetes until later in life, the increasing rate of childhood obesity is resulting in a similar rise in type 2 (formerly known as "adult onset") diabetes in teenagers. Experts estimate that about 45% of new diabetes patients are now identified in large pediatric centers (Fagot-Campagna 2000). The surge in the number of diabetic patients also has great implications for health-care expenditures. In 2007, the total national cost of diabetes in the United States was approximately $174 billion, and the average individual cost of treatment per year was $6,650 (American Diabetes Association 2008). Prevention of obesity, particularly in childhood, is clearly crucial in mitigating the health and economic impacts of the condition.

School Meals

Many school-age children receive one or more school meals a day, so the school food environment is an obvious place to address the childhood obesity epidemic. The U.S. Department of Agriculture (USDA) administers both the National School Lunch Program (NSLP) and the Commodity Food Program, which provides subsidies for surplus food items. (Many of these items are featured in school meals and are often selected to help reduce the cost of the meals.) Children whose families meet certain economic criteria are eligible for free or reduced priced lunches through the NSLP. The NSLP is a national entitlement program (similar to Food Stamps or Women, Infants, and Children [WIC]) whereby schools are reimbursed a set amount for each student that receives a free or reduced price meal (Food and Nutrition Services 2009b). In 2008, about 60% of school-aged children received their meals through this program (Food and Nutrition Services 2009a). Children of families who don't meet the criteria for the NSLP meals often independently purchase and consume these same meals.

School meals provided through the NSLP must meet standards based on the Dietary Guidelines for Americans, a joint publication on dietary advice by the

USDA and the Department of Health and Human Services (DHHS 2005). Such regulations stipulate that no more than 30% of calories in a school meal should be derived from fat, and less than 10% from saturated fat. Meals must also provide one-third of Recommended Daily Allowances for protein, vitamin A, vitamin C, iron, calcium, and calories over the course of one week of menus (NSLP 2009). School meals must meet these guidelines in order for the school district to be reimbursed by the government for serving school meals.

While there have been recent improvements in school meals, there is still much work to be done to prevent diet-related disease in addition to providing free or low-cost meals to students. There is widespread agreement among nutrition experts that fruits, vegetables, and whole grains promote health and help prevent the development of many chronic diseases. But by the USDA's own data, fewer than 2% of children met the USDA recommendations for fruit, vegetable, and whole grain consumption in 2001 (USDA 2001). Furthermore, national studies in 2003 found that more than 75% of schools exceeded the requirement that only 30% of calories come from fat (GAO 2003).

Many school meals are still centered around highly processed or fried meat, simple carbohydrates, and a lack of fresh fruits and vegetables, despite the fact that many nutritionists advocate decreasing the prevalence of meat-centered meals (processed meats, in particular) on school lunch menus. Excessive meat consumption has been linked to the rise in chronic diseases such as heart disease and diabetes (Walker et al. 2005). There is much scope for decreasing the frequency of meat-based school meals while still meeting nutrient recommendations. Given the large percentage of children who routinely rely on school meals means that taking such action could decrease the risk of developing chronic diseases.

Environmental Implications of Current Dietary Patterns

In addition to the significant health complications that are associated with current American dietary patterns, there are serious environmental implications that must also be considered. School meals can be seen as a microcosm of the significant waste and environmental degradation caused by our food system. Although Americans make up about 4% of the world population, we consume about 25% of the total fossil fuels (EIA 2009). In the United States, about 20% of this fossil fuel energy goes into the food system (Food and Water Watch 2009). This energy is used throughout the entire food cycle—from production to packaging to transportation to waste removal. With the ever-increasing reality of declining fossil fuel supplies and rising costs, there is a pressing need for the food system to become more energy efficient.

One of the most significant contributors of this fossil fuel dependence in our food system is the role of meat consumption. While the health impacts of excessive meat consumption were discussed above, there are also significant environmental consequences. On average, about 2 kcal of fossil fuels is invested to harvest 1 kcal of a plant food crop; by comparison, an average of 25 kcal is needed to produce 1 kcal of animal protein. This represents more than 10 times the energy input from fossil fuels needed to produce the same amount of plant protein. It is also estimated that 1 kg of animal protein requires 100 times more fresh water to produce than 1 kg of plant protein (Pimentel et al. 2006). Large-scale animal agriculture also contributes to other environmental problems, such as soil erosion, pollution of water supplies, waste build-up, and increased greenhouse gas emissions. Reducing meat consumption is therefore an effective way to make school meals both more energy efficient and less deleterious to the environment.

In addition to reducing meat consumption, there are many other ways to decrease the energy input of our current food system. The average American consumes about 2,146 lb of food each year, and about 82% of this food is processed. Approximately half of all energy end-use consumption is used to change raw materials (such as whole grains, fresh fruits and vegetables, legumes, and animal foods) into end products (processed foods; Okos et al. 1998). On average, food is transported between 1,300 and 2,000 miles from farm to table; this is another major contributor to fossil fuel consumption in the food system (National Sustainable Agriculture Information Service 2008). Finally, about 4% of U.S. petroleum is used to make plastic packaging for food products (Pimentel et al. 2006). Many food items sold in school cafeterias are prepackaged and wrapped in plastic. If schools were to replace prepackaged, processed foods with more locally grown foods prepared on-site, the total energy input could be significantly decreased.

While obstacles such as time, ease of preparation, tradition, and cost may slow changes to current practices, there are many steps that can be taken to make our food system more environmentally conscious. Viable solutions include: limiting meat consumption; increasing the intake of fresh fruits and vegetables and minimally processed whole grains; preparing meals on site; and purchasing local foods whenever possible. All of these strategies can be implemented at the school meal level.

Baltimore: A Case Study

The following section provides some background on the school meal system in Baltimore City, which serves as a case study for how meals can be improved nationally by prioritizing environmental and health concerns.

Baltimore, like many cities, has a high rate of participation in the USDA free and reduced lunch program, with 73% of its students qualifying. About 50,000 lunches are served each day in the Baltimore schools. Although the new food service director is making changes for the 2009–2010 school year, including Meatless Mondays, until this year a typical five-day lunch menu in Baltimore might include meatloaf, fish nuggets, hot dogs, cheeseburgers, and French bread

TABLE 1 MEAL NUTRITIONAL ANALYSIS: STANDARD MEAL COMPARED TO ALTERNATIVE MEAL

Nutrient	*Standard menu values*	*Healthy alternative values*
Calories	680	366
Total fat / saturated fat	26.7 g / 9.0 g	4.4 g / 0.8 g
Sodium	1,416 mg	750 mg
Cholesterol	43 mg	13 mg
Total carbohydrate	88.8 g	71.8 g
Protein	27.5 g	13.5 g
Fiber	5.1 g	15.5 g

Note: Menu analysis done by Melissa Mahoney, dietician, Baltimore City Public Schools, using USDA Nutri-kids software. Proportions for the standard meal included 1 white roll, 1 hot dog, 1/2 cup tater tots, 1/2 cup canned fruit in syrup, and 1/2 pint strawberry milk; the alternative meal included 1 cup casserole, 1 piece of cornbread, 1/2 cup cabbage salad, and 1 baked apple.

pizza, with fresh fruits and vegetables included in only one meal a week (Baltimore City Public Schools 2009). Food service directors work under tight budgets and face many obstacles to providing healthier meals. Yet despite this reality, many school systems across the country are developing strategies to procure and prepare meals that are more nutritious. For example, like Baltimore, many school systems are pairing with local farmers to purchase fresh fruits and vegetables.

As noted above, the nutritional content of school meals tends to be high in calories, fat, sodium, and simple carbohydrates, and low in whole grains, fresh fruits, and vegetables. Table 1 compares the nutritional content of a typical school meal—consisting of a hot dog on a white roll, tater tots, canned fruit in syrup, and strawberry milk (which meet current USDA nutritional guidelines)—with that of an alternative meal designed with an emphasis on USDA unprocessed commodity foods. This alternative meal consists of a casserole containing beans, squash, and corn; cornbread; cabbage salad; a baked apple; and water. This menu was chosen for its nutritional content and liberal use of healthy commodity foods, but also because it uses local, seasonal food items and can be prepared on-site from whole food, non-processed raw materials. As seen in Table 1, the alternative meal contains approximately half the calories and sodium, one-sixth the fat, and one-third more fiber than the typical meal, and it can be made with ingredients that are produced in the nearby community.

Besides improving students' diets, changing the nature of school meals can also positively impact the environment. Like Baltimore, many school systems prepare meals in a central kitchen. The central kitchen receives frozen, packaged, and canned foods from the Commodity Food program, which may be transported from sources all over the country, and then ships prepared meals to the individual schools for reheating. In Baltimore, until this year school meals arrived at the cafeteria tables through a particularly circuitous trip. Because there is no

TABLE 2 ENERGY INPUT (IN KCAL) PER INDIVIDUAL MEAL NEEDED FOR BALTIMORE CITY SCHOOL SYSTEM

Step in preparation of meals	*Energy input needed*
Cooking (in Brooklyn)	705
Transport (Brooklyn to Baltimore)	15
Reheating (Baltimore)	25
Producing Styrofoam tray	215
TOTAL ENERGY INPUT	**960**

Note: This energy analysis was by Dr. Pimentel (Pimentel and Pimentel 2008). It does not include the energy costs for transporting the materials necessary for the meals to the central kitchen in New York. As many of these items are harvested, processed, and packaged in large production and distribution centers around the country, there is an obvious significant fossil fuel energy input necessary before the food even arrives in New York. These fossil fuel inputs are included in Table 3.

central kitchen in Baltimore and (for various reasons) most of the individual school kitchens have been out of operation, the district has been under contract to have meals delivered by truck from Brooklyn, New York. The meals are precooked and assembled in New York and then transported three times a week to Baltimore. Once delivered to the schools, the hot foods are placed in warming ovens before being taken to the serving lines, and the cold food items are usually prepackaged. The foods are served on Styrofoam trays.

An analysis of the energy impact of providing each meal in this way is presented in Table 2. As can be seen, preparing meals hundreds of miles off-site, transporting them, and then reheating them once they arrive in Baltimore entails a high energy cost. However, the energy costs of providing meals for a week could be significantly reduced if meals were prepared on-site with local, fresh ingredients and if reusable dishes were used in place of Styrofoam trays.

While each meal requires a different amount of fossil fuel input prior to arriving at the kitchen, it is helpful to compare the energy costs of a standard meal to one that prioritizes energy efficiency. Table 3 shows an analysis of the energy input required to produce each item in the standard meal and in the alternative meal. The energy input estimate includes all steps in the process, from the time each ingredient is harvested until the ingredients are combined, processed, packaged, transported, heated, and served in the cafeteria. With all external factors considered, the standard meal requires three times the amount of energy to produce than the healthy alternative meal.

Energy inputs are often out of the scope of the school menu planners concerned with limited budgets and production capabilities. However, as fuel costs and childhood obesity rates continue to rise, the quality and production of student meals may become more of a priority. By focusing on the use of fresh, local ingredients, school meals can benefit the health of children, while lowering the negative impact on the environment.

TABLE 3 **MEAL ENERGY INPUT ANALYSIS: STANDARD MEAL COMPARED TO ALTERNATIVE MEAL**

Food item	*Approximate energy input needed to produce (Kcal)*
Standard meal	
Hot dog	1,600
White roll	588
Tater tots	40
Canned fruit in syrup	2,033
Strawberry milk	1,906
TOTAL	**6,167**
Alternative meal	
Bean, squash, and corn casserole	1,206
Cornbread	560
Cabbage salad	37
Baked apple	205
Water	0
TOTAL	**2,008**

Note: This analysis was done by Dr. Pimentel (Pimentel and Pimentel 2008).

CONCLUSION

The goal of this paper has been to look at school meals in a new light by considering both the health and environmental implications of menu planning and preparation decisions. Nearly 60% of school-age children across the country eat at least one meal at school five days a week. School cafeterias are therefore an important setting for addressing both children's nutrition and the energy costs associated with the food system. Currently, school meals have high amounts of saturated fat, cholesterol, sodium, and calories, and include limited amounts of whole grains and fresh fruits and vegetables. These meals could do more to limit and reverse the current childhood obesity epidemic. From an environmental perspective, meal preparation is often a multi-step process. This process involves procuring items from sources across the country where they are harvested, processed, and packaged, transporting food to a central kitchen for production, and then further transporting the meals to individual schools where they are reheated and served.

We offer an alternative meal plan strategy that prioritizes both student health and the environment. Menus would feature less meat and would contain more locally procured and minimally processed foods that could be prepared on-site. Because they would feature more fresh fruits and vegetables and minimally processed carbohydrates, these meals would be inherently healthier. By eliminating paying for processing whole commodity foods into fast foods and cutting transportation costs by utilizing more local ingredients, additional funds would be available to pay cafeteria workers to cook rather than reheat the meals. Furthermore, by decreasing the energy input needed for raising livestock, as well as decreasing the amount needed for processing, packaging, refrigerating, transporting, and reheating of foods, fossil fuel use would be decreased. Thus, by simultaneously focusing on childhood nutrition and environmental resource use, school meals could have the potential to address two of the major public health problems of our time.

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