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School Meals: A Nutritional and Environmental Perspective

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Introduction

The United States is experiencing denigration in health, education, and the environment, much of which can be attributed to our current food system and lack of mainstream awareness about these issues. It is estimated that approximately 2/3 of the US population is overweight or obese, and this has led to the considerable burden of diet-related disease in this country.[2] Of the seven most common chronic diseases in the US (cancers, diabetes, heart disease, hypertension, stroke, mental disorders, and pulmonary conditions), the first five have been associated with dietary practices. The total cost of these diseases in 2003, including treatment expenditures and lost productivity, was over $1,324 Billion.[3] In addition, the price of food in the U.S. has risen by 40% within the last year.[4] Current food practices are also leading to significant environmental degradation and high fossil-fuel inputs. The purpose of this paper is to address these contemporary problems by looking at them in a unique interdisciplinary manner and recommend viable sustainable solutions.

This paper presents a case study model by estimating the cost of providing hands-on, sensory-based education about food, nutrition, and agriculture by placing a trained food educator in 130 elementary and middle schools in Baltimore City where the authors[5] have been engaged in research. A purpose of food-based education is to teach students about how nutrients from food affect the way they feel, think and act. The

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[1] This paper was supported in part by the Abell Foundation, Baltimore, Maryland
[2] Milken Institute. "An Unhealthy America: The Economic Burden of Chronic Disease." Available at http://www.chronicdiseaseimpact.com/ebcd.taf?cat=risk&type=obese. Last accessed 9/10/08.
[3] Ibid.
[4] http://www.wsws.org/articles/2008/mar2008/food-m12.shtml
[5] Antonia Demas, Dana Kindermann

cost of this food literacy education is then compared to the medical and societal costs of some of the major diet-related diseases. Such a comparison allows the reader to put into perspective the comparative costs of prevention versus treatment for one of the major public health issues of our time. The authors also propose an alternative meal plan that might help to promote health among the students, and provide a comparison of the nutrient content between this approach and the current one.

After considering some of the major health and financial implications of the existing food system and in particular how this plays out in school meal programs, the paper goes on to consider the associated environmental costs. In this section, the authors address issues such as meat consumption, transportation and food miles, packaging and the amount of land that is required per pupil per year to produce the currently offered meals. The authors then make predictions of the potential differences in energy and environmental costs between the alternative meal plan and the current meal plan. Thus, this paper compares the cost of classroom education about food, nutrition, and agricultural issues to the cost of treating diet-related diseases and examines some of the current environmentally unsustainable practices in food production.

Childhood Obesity

The U.S. rate of childhood obesity has more than doubled over the past two decades.[6] Children are at special risk of developing life-long chronic diseases because the habits they form while young become increasingly difficult to change as they enter adulthood. Childhood obesity is of grave concern because it can be a gateway condition for a host of chronic, diet-related diseases such as heart disease, type-2 diabetes, gallbladder disease, osteoarthritis, and some types of cancer. Many of the diet-related diseases are now appearing in children as young as age seven. For example, a recent study found that obese children begin to show signs of heart disease at a much younger age than previously expected.[7] Because of the lifelong financial and quality of life impacts of chronic diseases, it is crucial that greater effort be placed on early prevention.

One important way to address the growing problem of childhood obesity is through a concerted educational effort that will provide students with the intellectual skills they need to make healthy food choices. Children need to understand the connection between nutrition and health so that they will be able to make wise decisions to protect their health and prevent disease. Schools represent the ideal setting to provide such education; the meals provided at school should then reflect and reinforce these lessons and facilitate healthy food behaviors.

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[6] http://www.obesity.org/subs/childhood/prevalence.shtml

[7] Lorch SM, Sharkey A. Myocardial Velocity, Strain, and Strain Rate Abnormalities in Healthy Obese Children. Journal of Cardiometabolic Syndrome. 2007 Winter; 2(1):30-4.

School Meals

One of the major contributing factors in the childhood obesity epidemic is the school food environment. Schools serve children breakfast and lunch every day and should be models of health-promoting meals and practices. In order to accomplish this, there must be educational coordination between the classroom and the cafeteria in which teachers and food service support each other's efforts.

The USDA (United States Department of Agriculture) administers the school meals programs. They are also responsible for the Commodity Program that provides subsidies for surplus food items, which are then served in school meals. In many cases, the commodity foods served to children are not selected with nutrition as a main criterion as many of these items are highly processed such as chicken nuggets.

By USDA's own data, fewer than 2% of children meet the USDA recommendations for fruit, vegetable, and whole grain consumption.[8] There is widespread agreement among nutrition experts that fruits, vegetables, and whole grains promote health and help prevent the development of many chronic diseases.[9] In fiscal year 2007, USDA estimates that 30.5 million children consumed school-provided meals each day[10], and many children eat these meals for up to twelve years. Unfortunately, more than 85% of U.S. schools exceed the limits set for saturated fat content in school meals.[11] Children from lower-income families are especially vulnerable because they rely on free and reduced-price meals from the USDA-run breakfast and lunch program for at least two-thirds of their daily calories. They may also eat USDA snacks if they participate in after-school programs held at the school.

The USDA has a protein, grain, fruit, vegetable, and milk requirement that must be met in order for the school district to be reimbursed by the government for serving school meals. The protein is usually a processed meat item such as a hot dog and is often deep-fried such as chicken nuggets. The grain is typically white bread or the breading that goes on to fried products. The vegetable is often French Fries. The most commonly offered fresh vegetable is iceberg lettuce, of which 95% is water. The fruit is often processed in corn syrup or provided as "juice," which is mainly sugar in the form of high fructose corn syrup.

Milk is required for every meal despite the fact that many of the students who qualify for free or reduced meals are lactose intolerant. In particular, about 60-80% of African Americans, 80% of Hispanics, and 100% of Asian and Native Americans are lactose intolerant; in contrast, about 2% of Northern Europeans are lactose intolerant.[12] The symptoms of consuming lactose-containing foods when one is lactose intolerant include nausea, abdominal pain, and flatulence. Furthermore, the flavored chocolate

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[8] "Children's Diets in the Mid-1990's," U.S. Department of Agriculture, January 2001
[9] Campbell, T. Colin, The China Study, The Most Comprehensive Study of Nutrition Ever Conducted, Benbella Books, Dallas, TX, 2004.
[10] http://www.fns.usda.gov/cnd/Lunch/AboutLunch/NSLPFactSheet.pdf
[11] "School Nutrition Dietary Assessment Study II: Summary of Findings," US Department of Agriculture, April 2001, http://www.fns.usda.gov/oane/MENU/Published/CNP/FILES/SNDAIIfindsum.htm
[12] http://www.medicinenet.com/script/main/art.asp?articlekey=63934

and strawberry low-fat milks (1% milk actually gets 23% of its calories from fat, 2%, 35% calories from fat) contain added sugars with the second ingredient as high fructose corn syrup. The added sugar in 1% chocolate milk adds 13 grams to the total 25 grams of sugar and supplies 170 calories in this drink; the sugar added to 1% strawberry milk adds 17 grams of sugar to this drink's total 29 total grams of sugar and supplies 180 calories[13]. In contrast, Mountain Dew is 31 grams total sugar and 110 calories. So the flavored milks are more calorie dense than the typical soda.

In a report issued by the nutrition division of the American Association of Pediatrics, despite recognition that the vast majority of non-European ethnic groups are lactose intolerant, children are recommended to consume 2 servings of milk/dairy products (though in smaller servings or partially fermented in the form of yogurt or cheese for lactose intolerant individuals). This recommendation is based on a concern about calcium deficiency and a belief that children will not consume other calcium-rich foods such as dark green vegetables.[14]

While the authors of this paper agree with the importance of meeting the recommended intake of calcium for proper growth, introducing children to calcium-rich vegetables would provide additional health benefits and would avoid the problem of lactose intolerance. When one considers that the majority of minority students come from ethnic backgrounds that have a high prevalence of lactose intolerance and are the primary recipients of free USDA meals where dairy is their required beverage, it makes sense that GI disturbances would result after consuming milk. Educators need to look at this fact as a possible contributor to behavior disturbances. Also, most students do not have ready access to water and are likely dehydrated to some degree, especially in the warmer months. This results in cramps and headaches which also affect student performance yet hydration if rarely addressed as an issue affecting student behavior.

Environmental Implications of Current Diet

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. Although Americans make up about 4% of the world population, we consume about 25% of the total fossil fuels.[15] In the US, about 19% of this fossil fuel energy goes to the food system.[16] This energy is used throughout the entire food cycle – from production to processing to packaging to transportation to waste removal. With the ever-increasing reality of decreasing fossil fuel supplies and increasing costs, there is a pressing need for the food system to become much more energy-efficient.

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[13] Bowman, Ruth A, Dissertation, University of Minnesota, January, 2007, page 60. (Dr. Bowman studied the FFL program and the Baltimore school lunch program as part of her dissertation research).

[14] American Heart Association, Gidding S, Dennison B, Birch L, Daniels S, Gilman M, Lichtenstien A, Thomas K, Steinberger J, Stettler N, and Van Horn L. Dietary Recommendations for Children and Adolescents: A Guide For Practitioners. Available at: aappolicy.aappublications.org/cgi/reprint/pediatrics;117/2/544.pdf. 8/24/05. Last Accessed 9/20/2008.

[15] **Dunn 2001 – NEED SPECIFIC REFERENCE. From Pimental's article on Food Energy Inputs.**

[16] **Pimental. Food Energy Inputs article – NEED SPECIFIC REFERENCE. 2006.**

One of the most significant contributors of this fossil fuel dependence in our food system is the role of meat consumption. It has been estimated that the average American consumes approximately twice as much protein as the recommended daily allowance (RDA is 46-60 g).[17] The average American consumes about 114 g of protein each day, of which 74 g is animal-based protein.[18] On average, about 2 kcal of fossil fuels is invested to harvest 1 kcal of a crop; in comparison, an average of 25 kcal is needed to produce 1 kcal of animal protein. This represents greater than 10 times the energy input needed to produce the same amount of grain protein.[19] In addition, about 45 million tons of plant protein is fed to livestock each year just to produce 7.5 million tons of animal protein.[20] The following table shows the differences in energy input to energy output for various plant-based and animal-based protein[21]:

	Food	**Input:Output Ratio (kcal)**
Plant-based protein	Corn (conventional)	1:4
	Soybean	1:3.8
	Rice	1:2
	Wheat	1:2.1
	Potato	1:1.3
	Cabbage	1:1.3
	Orange	1:1
	Apple	1:0.61
	Tomato	1:0.26
Animal-Based Protein	Lamb	57:1
	Beef Cattle	40:1
	Grass-fed cattle	20:1
	Pork	14:1
	Turkey	10:1
	Chicken	4:1
	Eggs	39:1
	Milk	14:1

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[22]; about 82% of this food is processed.[23] About 55% of fruits and vegetables, 100% of flour and other cereal products, and 99% of caloric

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[17] **Mathews 2006 - NEED SPECIFIC REFERENCE. From Pimental's article on Food Energy Inputs.**
[18] **FAOSTAT 2005 NEED SPECIFIC REFERENCE. From Pimental's article on Food Energy Inputs**
[19] **Pimental. Food Energy Inputs article – NEED SPECIFIC REFERENCE. 2006**
[20] **Pimetnal 2004 - NEED SPECIFIC REFERENCE. From Pimental's article on Food Energy Inputs.**
[21] Pimental. **Food Energy Inputs article – NEED SPECIFIC REFERENCE. 2006**
[22] USCB 2007
[23] USDA 2006.

sweeteners are processed.[24] Breakfast cereals and freeze-dried foods (such as frozen vegetables) are among those foods that utilize the largest amount of energy for processing.

Energy costs can be further reduced by changes in packaging, transportation, and waste production and removal. About 4% of US petroleum is used to make plastic packaging.[25] In addition to the necessary high-energy input, disposal of plastic is a major problem; plastics last between 200-500 years in a landfill.[26] On average, food is transported about 2,400 km from farm to table, leading to significant fossil fuel input and environmental degradation.[27] Finally, there is considerable waste in our current food system. Americans are supplied with an average of 3,800 kcal of food each day; of this only about 2,744 kcal are consumed and 1,026 are lost as wasted food.[28]

While there are many obstacles in the way of change to our current food system, there are many steps that can be taken to decrease or lessen the environmental impacts. Viable solutions include: limiting meat consumption; increasing intake of fresh fruits and vegetables and minimally processed whole grains; purchasing local foods whenever possible; growing more foods in personal or community gardens; preserving seasonal food via low-input technologies such as root cellars and drying, and decreasing both daily caloric intake and the amount of food waste. All of these strategies can be implemented at the school-meal level.

Baltimore: A Case Study

Baltimore City

Childhood obesity and its related diseases is a national concern, and are especially prevalent in some of our big cities. Baltimore has been consistently rated among the top 25 cities in the U.S. with the highest rates of obesity over the past five years.[29] It is critical that concerted efforts are made to educate children to try to prevent the development of obesity and the chronic diseases that are associated with it. Minority students are especially vulnerable as reflected in the chart below, developed by the Center for Disease Control.[30]

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[24] USDA 2003.
[25] Pimental 2006 – Food Energy Inputs.
[26] Earthshell 1999, Pavlath and Robertson 1999.
[27] Pirog and Benjamin 2003. WorldWatch 2002.
[28] USDA 2003.
[29] Men's Fitness. 2005, 2004, 2003, 2002, 2001 & 2000. U.S. Census Bureau statistics were used to determine the most populated U.S. cities at the time of the survey. Fourteen categories were used as "indicators, risk factors or relevant environmental determinants affecting fitness, obesity and health."
[30] Source: CDC, National Center for Health Statistics, National Health and Nutrition Examination Survey. Ogden et. al. JAMA. 2002;288:1728-1732.

	Children (Ages 6 to 11) Prevalence (%)		Adolescents (Ages 12 to 19) Prevalence (%)	
Race	Overweight	Obesity	Overweight	Obesity
Black (Non-Hispanic)	35.9	19.5	40.4	23.6
Mexican American	39.3	23.7	43.8	23.4
White (Non-Hispanic)	26.2	11.8	26.5	12.7

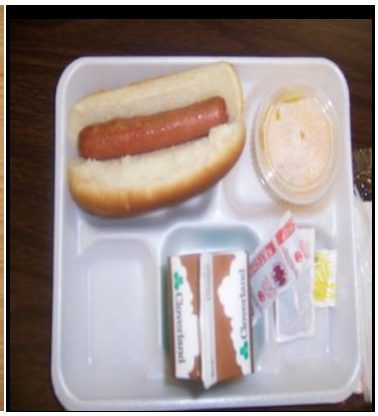
According to figures from the U. S. Census Bureau,[31] 64.3% of the population within the city of Baltimore is African American, 31.6% is White, 1.7% is Hispanic or Latino, and 1.5% is Asian. Therefore, the majority of students in Baltimore are at a higher risk than the national average for developing obesity-related problems.

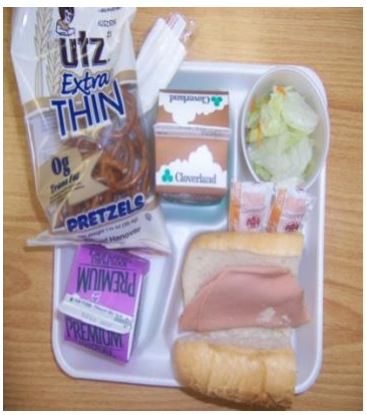
Poverty is also associated with increased risk for diet-related diseases. Childhood poverty has been cited as the greatest predictor of heart disease because of its association with limited access to nutritious foods, poor shelter, and added stress.[32] Within the City of Baltimore, according to the 2004 Census figures, 21.5% of the population lives below the poverty line compared to the state of Maryland average of 9.2%.[33]

Baltimore School Meals

The typical school meal nationwide relies on processed foods. One can see from the pictures taken below of typical meals served in Baltimore schools that the meals are high in processed meats and contain little/no whole grains, fruits or vegetables. (The authors hope there will be changes next year due to the hiring of a new food service director and superintendent who are both supportive of school meal reforms).

[31] http://quickfacts.census.gov/qfd/states/24/2404000.html
[32] http://mailman1.u.washington.edu/pipermail/pophealth/2002-September/000370.html
[33] http://quickfacts.census.gov/qfd/states/24/24510.html





Baltimore School Meals, 2006
These meals meet the "Nutrient Requirements" of USDA

Baltimore, like many cities, has a high rate of participation in the USDA free and reduced lunch program with 73% of its students qualifying. The district has been under contract to have meals trucked up from Brooklyn, New York because they do not have a central kitchen in Baltimore and most of the individual school kitchens have been out of operation. Meals are pre-cooked and assembled at the New York location and then trucked to all of the Baltimore City schools. Although the new food service director wants to change this system, he is under contract to continue it until the contract.

To summarize the energy impact of delivering meals to schools in the current system the following figures have been calculated:[34]

Approximately 50,000 lunches transported 3X/week from Brooklyn, New York and delivered to Baltimore schools

Kcal of energy for current system:

2,830,000 Kcal to transport from NYC
60 Million Kcal to cook
25 Kcal to re-heat
Total energy: 368 Million Kcal of energy

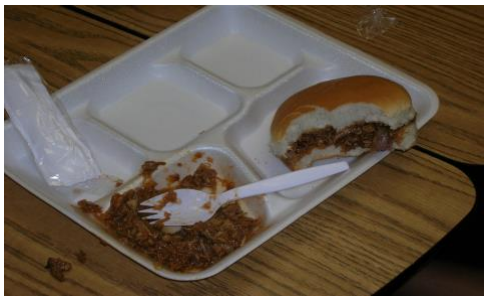
Kcal if meals prepared in Baltimore
60 Million Kcal to cook

Difference: 308 Million Kcal of energy

Once delivered to schools within the City, the hot foods are then placed in warming ovens before taken to the serving lines and put on trays along with the cold items which

[34] David Pimentel, Cornell University, 2008

are usually prepackaged. The foods are served on Styrofoam trays that are tossed in trash containers along with any uneaten foods when the students have finished their meals. Each Styrofoam tray takes approximately 215 kcal of energy to produce. The plastic bags lining the trash cans are then put in dumpsters and taken to the landfill. The time allowed for the lunch period is limited with a significant amount of it consisting of students waiting in line to be served food and after eating, exiting the cafeteria.



Each Styrofoam tray takes approximately 215 kcal of energy to produce

Another issue that is noteworthy concerns the fact that in most schools lunch comes before recess. Students have been sitting in chairs all morning with limited movement. This sedentary condition is not a natural state of childhood and most schools have either eliminated or drastically reduced physical education programs. Recess may be the only time that students have an opportunity to play and exercise during the school day. Therefore, they are usually anxious to get out onto the playground and this makes them eat even faster. The noise level of the cafeteria is not conducive to lingering over a meal[35] which further encourages students to eat fast and get out onto the playground.

The Food Literacy Program in Baltimore – Food for Life

Better food choices and physical activity are often cited as two major solution areas to the health concerns facing our youth. Food choice is an especially, complex issue that is bound with culture, family, income level, public policy, and industry input. Since schools already play a substantial role in providing food to students and their mission is to educate, they are the ideal place to initiate a positive food literacy program.

The food literacy program that began in Baltimore in 2004 conducted by the Food Studies Institute through grant funds[36] is known as Food for Life (FFL). FFL provides a school-based, whole-community approach to the problem of student health, behavior, and academic achievement. The strategy is to promote healthful eating habits and

[35] As part of her Ph.D. dissertation, Cornell University, Dr. Demas found it to be at least 90 decibels.
[36] Grants over the past 5 years have come from the Weinberg Foundation, the Abell Foundation, Roswell Foundation, Kreiger Foundation, Baltimore Community Foundation, Center for a Livable Future, Johns Hopkins, Stop and Shop Foundation.

physical activity among at-risk children and involves parents, teachers, school administrators, foodservice personnel, health and educational professionals, and community members. It is part of a research-based program that utilizes the award-winning curricular strategy[37] through the Food is Elementary (FIE) curriculum that has been successfully implemented in more than 1,500 schools nationwide. By January, 2008, FFL was in eight Baltimore City public schools[38].

The approach of FIE in introducing food and nutrition concepts is pleasure-oriented rather than fear-based. Kids get "turned on" to experiencing health-promoting foods they may not be familiar with, rather than "turned off" to nutrition. FIE does not stigmatize students for their weight or size and promotes positive body images. The skills students learn through FIE are designed to have direct practical application, enhance their life skills, improve their quality of life, encourage an appreciation of people around the world, and acceptance of diversity. Exercise is integrated into the units as students move to music from the culture studied and engage in traditional exercise or dance of that culture. Tapes of music from around the world are used with each unit so that students appreciate the musical sounds that have evolved as cultural expressions in diverse regions of the world. This promotes music appreciation as well as understanding of basic rhythms and instruments.

Comparison of typical meals and recommended meals

In this section, an alternative lunch menu has been proposed and analyzed. This meal plan has been developed with both nutrition and energy inputs in mind. Whenever possible, fresh local foods should be used in place of canned or frozen foods. Students typically are not in touch with seasonality because they are detached from food production and can eat tropical foods year round in cold climates. Also, this plan significantly decreases the amount of meat-based protein, and increases the amount of calcium derived from non-dairy sources. We recommend cooking on-site; this allows for decreased reliance on processed, pre-packaged foods, fewer food transportation miles, and a significant reduction in the amount of Styrofoam and plastic wrapping. Finally, the meals will hopefully be appealing to students (which will be more likely after student exposure to these foods through the food literacy program), and therefore food waste will be decreased.

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[37] Demas, Antonia, Ph.D., *Food Acceptance in the Elementary Classroom as a Means of Gaining Acceptance of Diverse, Low-fat Foods in the School Lunch Program*, Dissertation, Cornell University, January, 1995. Awards: USDA, *Most Creative Implementation of the Dietary Guidelines*, 1994; Society for Nutrition Education, *Excellence in Nutrition Education*, 1994/

[38] Hampstead Hill Academy, Stadium School, Green School, Southwest, City Springs, Patterson Park, Midtown Academy, Mount Washington – all public inner-city schools.

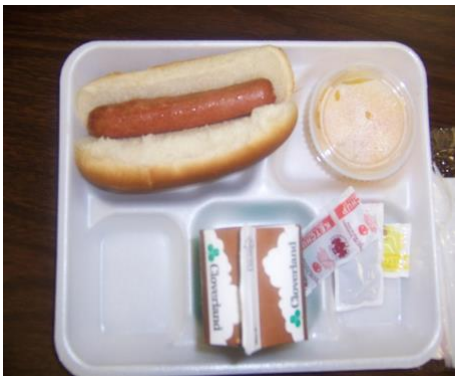
Menu Analysis

Standard Lunch Menu

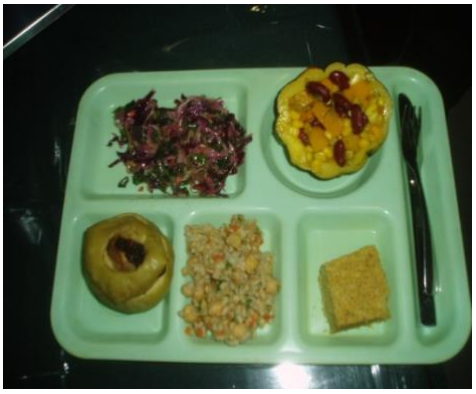
- Hot Dog – 1 each
- White Roll – 1 each
- Tater tots – ½ cup
- Canned fruit in syrup – ½ cup
- Strawberry milk – ½ pint

Healthy Lunch Alternative

- 3 Sisters Casserole (kidney beans, squash, corn) – 1 cup
- Cornbread – 1 serving
- Cabbage Salad – ½ cup
- Baked Apple – 1 each
- Water - 16 oz



Baltimore Standard School Lunch



Healthy School Lunch

Menu Analysis – done by Melissa Mahoney, dietician, Baltimore City Schools using USDA Nutri-Kids software

Nutrient	Standard Menu Values	Healthy Alternative Values
Calories	680	366
Total Fat/ Saturated	26.74 / 9.03 grams	4.40 / 0.79 grams
Sodium	1416 milligrams	751 milligrams
Cholesterol	43 milligrams	13 milligrams
Total Carbohydrate	88.76 grams	71.81 grams
Protein	27.47 grams	13.49 grams
Fiber	5.07 grams	15.45 grams

The typical lunch has approximately double the number of calories, six times as much fat, double the sodium, and a third as much fiber as the healthy alternative. The figure concerning cholesterol for the healthy menu is not accurate because the computer program does not recognize cornbread made without eggs or butter. The accurate figure should be zero cholesterol for the healthy alternative meal.

In terms of the approximate amount of kcal in energy to produce the above meals, the breakdown is as follows:[39]

Energy Inputs for Standard vs. Healthy Lunch

Standard Lunch Menu	**Inputs (kcal)**
• Hot Dog – 1 each	1600
• White Roll – 1 each	588
• Tater tots	40
• Canned fruit in syrup	621
• Strawberry milk	3327
Total	**6176**
Healthy Lunch Alternative	
• 3 Sisters Casserole	
• kidney beans	136
• Squash	510
• Corn	560
• Cornbread	600
• Cabbage Salad	37
• Baked Apple	205
• Water - 16 oz	0
Total	**2048**

The amount of calories of energy to produce the typical, unhealthy lunch is approximately three times as much as a healthier seasonal menu.

As can be seen in the above tables, there are considerable differences in both nutrient content and potential environmental impact of the two meals. These differences have significant implications for both the health of the students as well as the health of the planet.

The average food has traveled approximately 1500 miles[40] before it reaches our table. It is estimated that the amount of land required per child to grow enough food to sustain them for a year is one acre. This figure is up to a third less if the child is vegetarian or vegan.[41] Our current agricultural practices are depleting the nutrients in our soil at an alarming rate. It is estimate that it takes approximately 500 years to replace one inch of topsoil.[42] In addition, 1 kg of animal protein requires 100 times more fresh water to produce than 1 kg of plant protein.[43] US livestock currently consume 7 times more grain (in the form of whole grains) than US human population.

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[39] David Pimentel, 2008
[40] Pimentel *et al* : Reducing Energy Inputs in the US Food System
[41] Ibid.
[42] Pimentel, Kounang, 1998
[43] Pimentel

The grains consumed by US livestock could feed approximately 840 million people if they followed a plant based diet[44] and therefore could help to alleviate world hunger.

The above analysis considered the nutritional and environmental advantages of choosing a meal plan that is based upon locally procured, plant-based meals that are prepared on-site. The FFL program should serve as an impetus for school meal reform by educating students and providing positive exposure to healthy, plant-based foods. This education will likely increase students' acceptance of healthier meals once they are offered as part of the school meals.

Cost Analysis

In addition to understanding the immediate nutritional differences between the meal options, it is valuable to consider the long-term health and economic implications of exposing children to an educational program that will make them want a healthier meal from a young age. To that end, the authors conducted a cost analysis of expanding the FFL program to the approximately 130 public elementary and middle schools in Baltimore City.[45] Cost analyses are useful because they can help inform resource-allocation decisions. Once an inventory of the resources and associated costs necessary for a program has been compiled, policy makers can then more easily decide between one or more potential program options. Threshold analyses can also be done to determine whether a program can be labeled cost-saving and/or cost-effective. A program is considered cost-effective if it achieves an overall balance of costs to consequences.[46]

To conduct the cost analysis, the author[47] chose a time period for the FFL program to be delivered, and inventoried all the costs expected during that time. Please see the appendix for the full version of this paper. The time period chosen for this analysis was one school year, or approximately nine months. The number of students served was estimated to be 13,000. This number was chosen because about 100 students per school currently participate in the program as it has been implemented in the eight Baltimore City schools. There are about 130 public elementary and middle schools in Baltimore City, and if we assume that 100 students would participate in each of these schools, then a total of about 13,000 students would be included in the scale-up. The program would include one hour of formal food education per week for each class, as well as several opportunities for after-school food and gardening activities.

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[44] Pimentel & Pimentel, 2003

[45] The original version of this cost analysis was submitted by one of the authors of this study as a term paper for a class entitled "Translating Research Into Public Health Programs and Policies," taught by David Holtgrave at the Johns Hopkins Bloomberg School of Public Health. A full copy of this paper can be found in the appendix.

[46] Trentacoste N, Holtgrave D, Collins C, and Abdul-Quader A. "Disseminating Effective Behavioral Interventions for HIV Prevention: A Cost Analysis of a Risk-Reduction Intervention for Drug Users," *Journal of Public Health Management Practice* 10, no. 2 (2004): 130-139.

[47] Dana Kindermann did this for one of her classes at Johns Hopkins as a graduate student with assistance from Antonia Demas and others

The cost of implementing the program in 130 schools so that 13,000 students would be able to participate would be approximately $229 per student, or $22,900 per school. The most significant costs included the salary of the food educators (one per school), as well as the cost of the cooking supplies, food for each class, and gardening materials (each school would have a school garden). While the upfront costs of expanding the FFL program to all public elementary and middle schools seem high, this must be seen in light of the value of promoting healthy lifestyles and prevention of diet-related disease.

In 2007, the total national cost of diabetes in the U.S. was estimated at $174 billion (including cost of treatment and lost productivity), and the average individual cost of treating diabetes for one year was about $6,650.[48] Experts estimate that about 45% of new diabetes patients are being identified in large pediatric centers,[49] and a recent CDC study estimated that 1/3 of children born in 2000 will develop diabetes in their lifetime.[50] As the students participating in the FFL program are elementary school and middle school age, many fit into this category. Based on this model, it can be estimated that about 4,333 of the 13,000 students who might participate in the FFL program will develop diabetes in their lifetime. If we then compare the cost of the FFL program per person ($229) to the average cost of treating diabetes for one year ($6,650), the cost now seems relatively small.

The authors then determined how many cases of diabetes would need to be prevented for the FFL program to be considered cost effective. The net cost of implementing the FFL program in 130 Baltimore City schools can be estimated by subtracting the product of the cost of treating diabetes for one year and the number of cases of diabetes averted because of participation in the program from the cost of the program. If the net cost is negative, it can be considered cost-saving. The formula is as follows:

Net Cost = Cost of FFL Program – (# cases of diabetes averted)(cost of diabetes/year)

Because we don't know how many cases of diabetes might be averted among the 13,000 students that would participate in the FFL program, the true net cost can't be determined. Instead, threshold analyses can help determine how many cases would need to be averted for the net cost to be zero (the cost-saving threshold). If the net cost is zero, the formula can be rearranged as follows:

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[48] American Diabetes Association. "Economic Costs of Diabetes in the U.S. in 2007," *Diabetes Care*, 31, no.3 (2008):1-20.

[49] Fagot-Campagna, A. "Emergence of type 2 diabetes mellitus in children: epidemiological evidence." *Journalof Pediatric Endocrinology & Metabolism* 13 (2000) 1395-402.

[50] Narayan KM, Boyle J, Geiss L, Saaddine J, Thompson T. "Impact of Recent Increase in Incidence on Future Diabetes Burden, US, 2005-2050," *Diabetes Care*, Vol 29, no. 9 (2006): 2114-1226.

(Cost of FFL program)/ (Cost of diabetes/year) = # of cases averted

If we estimate that 4,333 students develop diabetes, their total average cost of treatment for one year would be $28,814,450 (4,333 students x $6,650). The cost of the FFL program for one year for 13,000 students has been estimated as $2,536,928. Therefore, 0.88 cases of diabetes must be prevented (for at least one year) by the FFL program for it to be considered cost saving ($2,536,928 /$28,814,450 = 0.088 cases). In other words, the program would need to prevent less than one case of diabetes among the 4,333 students that would be expected to develop the disease to be considered cost effective.

Diabetes is only one chronic disease that has been shown to be heavily influenced by diet and exercise. The following table outlines several other diet-related diseases, which now cause the greatest morbidity and mortality in this country, and their estimated costs to society[51]:

Disease/Condition	Estimated Yearly Societal Cost (treatment and lost productivity) (in Billions of US Dollars)	Percent of Americans with condition
Obesity/Overweight	78.5	65
Hypertension	312	12.6
Heart Disease	169.35	6.6
Stroke	35.69	0.8

As stated earlier, five of the seven most common chronic diseases in this country are associated with diet and exercise lifestyle choices (diet related: diabetes, heart disease, hypertension, stroke, cancer, + / - diet related: mental disorders and pulmonary conditions). While no direct association is currently available, it might be expected that students participating in a food literacy program such as FFL would have a decreased risk of developing some of these diet-related diseases. As the upfront costs of this program are significantly smaller than the cost of these diseases, there is a clear value of expanding the FFL program to a greater number of schools.

Summary comparing cost of FIE and Diabetes

[51] Statistics on Heart Disease, Hypertension and Stroke from The Milken Institute's 2003 Report: "An Unhealthy America: The Economic Burden of Chronic Disease." Available at http://www.chronicdiseaseimpact.com/ebcd.taf. Statistics on Obesity/Overweight from the CDC: "Overweight and Obesity: Economic Consequences." Last updated 5/2007. Available at http://www.cdc.gov/nccdphp/dnpa/obesity/economic_consequences.htm

- The analysis found that if FIE could prevent one case of Diabetes among the 130 schools participating (about 13,000 students), the program could be considered cost-saving
- The estimated average per person cost of FIE for one year is about $229
- The average cost of diabetes treatment for one year is $6,650.
- About 1/3 of young people are expected to develop diabetes in their lifetime
- If the program could prevent 1 case among the 4,333 students expected to develop diabetes (1/3 of 13,000), it would be cost-effective to implement the program

Conclusion and Recommendations

The above analysis used Baltimore City as a case study of the value of reforming school meals with greater consideration given to their health, educational, and environmental implications over time. The current meal plan is contributing to the spiraling epidemic of child obesity and the health complications that will undoubtedly result from this. It is also centered around meals which require a high energy input to produce but are deficient in many of the nutrients required for health promotion. Under the current system, these meals contribute to significant waste environmentally because of the extensive amount of packaging used, most of which ends up in landfills. Very few schools have a substantial food composting systems in place and most of the food items that end up in the trash would not be appropriate for composting because they contain animal product and are heavily processed with chemicals.

The authors have suggested an alternative meal plan strategy that is based on plant-based, locally procured and prepared meals. The acceptance of such meals should be paired with an effort to educate and expose children to alternative and healthier foods through a weekly food literacy class integrated with the academic curriculum. The analysis indicates that adopting a food literacy program such as FFL and reforming school meals will have significant economic, health, educational, and environmental benefits.

It is unrealistic to mandate Wellness Policies that set guidelines for nutrition education without funds for implementing these policies or consequences for not putting them in action. While the intention of raising awareness about student health concerns is important, it needs to be supported by appropriate resources to carry out the plan. The FFL program's current dependence on grant funds limits broader implementation of the program.

In addition to the health implications of traditional school-provided breakfast and lunches, there are also potential student behavior and academic implications connected to serving these meals. Though complex in nature from a sociological, physical, and psychological perspective, student behavior and academic performance can be linked in varying degrees, to poor nutrition. Yet very few schools, researchers, or policymakers have addressed these issues in an integrated manner that directly focuses on the unique role nutrients play in terms of these issues. We literally "are what we

eat," and to overlook this fundamental principle is to potentially compromise any other intervention aimed at improving the lives and performance of students on a basic and sustainable level. There is an urgent need to do research in this area. We need to study how early nutrition education can affect health, behavior, and academic performance of the child, and secondarily, impact their families.