QUALITY OF DIETARY INTAKE AT SCHOOL LUNCH OF MIDDLE SCHOOL STUDENTS BASED ON SOCIOECONOMIC STATUS

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BY

ASHLEY R. FITHIAN, BS

DENTON, TEXAS

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TEXAS WOMAN'S UNIVERSITY
DENTON, TEXAS

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To the Dean of the Graduate School:

I am submitting herewith a thesis written by Ashley R. Fithian entitled "Quality of Dietary Intake at School Lunch of Middle School Students Based on Socioeconomic Status." I have examined this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science with a major in Nutrition.

Karen Moreland

Karen Moreland, M.S., Major Professor

We have read this thesis and recommend its acceptance:

Department Chair

Accepted:

Jennifer Martin

Dean of the Graduate School

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ABSTRACT

ASHLEY R. FITHIAN

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AUGUST 2008

Ensuring adequate dietary intake at school lunch for optimal adolescent growth and development is important; however, few studies have assessed the quality of dietary intake at school lunch based on socioeconomic status (SES). In the 2005-2006 school year, 6,756 lunch records were completed weekly by random, anonymous students at participating low- and middle-SES middle schools in Harris County, Texas and analyzed for nutrient and food group intake. Independent t-tests of the collected data showed a significant difference ($p < .05$) in lunch consumption based on SES. Students attending low-SES schools had greater reported intake of protein, vitamin A, vitamin C, and calcium, and less intake of energy, total fat, and iron than the middle-SES school students. Low-SES school students also consumed fewer foods of minimal nutritional value. However, students at both SES levels are failing to meet overall nutritional expectations set by National School Lunch Program (NSLP) guidelines.

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CHAPTER I

INTRODUCTION

At the beginning of the century, 10 million households in the US, or 9.7% of all US households, claimed to be food insecure. Food insecurity is defined as "limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire foods in socially acceptable ways" (Nord, Jemison, & Bickel, 1999, p. 2). Poverty and food insecurity are associated with lower food expenditure, decreased fruit and vegetable consumption, and lower quality diet. Food costs can be a barrier to dietary change and may negatively affect diet quality (Drewnowski & Specter, 2004).

Risk of food insecurity is increased in households with children, single-parent households where the family head has less than 12 years of education, and households that do not have health insurance (Drewnowski & Specter, 2004). Poor nutritional health can put children and adolescents at increased risk for acute and chronic diseases as well as educational and social deficits. Short-term problems include growth retardation, iron deficiency anemia, poor academic performance, and development of psychosocial difficulties (Stang & Bayerl, 2003). Jyoti, Frongillo, and Jones (2005, p. 2835) reported on the effects of food insecurity in early childhood including "...impaired academic performance in reading and mathematics for boys and girls, decreased social skills for boys, and greater weight gain and BMI gains for girls". The long-term consequences of poor nutritional health include increased risk for

development of type 2 diabetes, cardiovascular disease, cancer, obesity, stroke, and osteoporosis (Nicklas & Johnson, 2004).

Low-income students are likely to participate in government-funded programs including those that provide free or reduced-priced meals. In 1946, the largest child nutrition program was established through the United States Department of Agriculture (USDA), the National School Lunch Program (NSLP), which now has greater than 30 million student participants (USDA, 2007). This program provides federal reimbursement in the form of cash and commodity foods to public and non-profit private schools and residential childcare institutions. Furthermore, free or reduced-priced meals are available to income qualifying students (Food and Nutrition Service [FNS], 1998).

The National School Lunch Act requires NSLP schools to adhere to the most recent Dietary Guidelines for Americans, updated in 2005, when planning school menus. The guidelines specify that no more than 30% of calories come from total fat and less than 10% of calories come from saturated fat. Furthermore, the lunches must provide at least one third of the Recommended Dietary Allowances (RDA) for calories, protein, vitamin A and C, iron, and calcium (USDA, 2007). However, these standards are not applicable to foods or beverages sold outside of the school meal programs such as non-reimbursable *a la carte* items including food from vending machines, school stores, or snack bars (Fox, Crepinsek, Connor, & Battaglia, 2001).

The NSLP has come under scrutiny because the School Nutrition Dietary Assessment – I (SNDA-I) conducted in 1991-92 revealed that schools were not serving

meals that met the dietary guidelines, particularly with regard to meeting the recommendations for total and saturated fat. A statistically significant improvement was seen with the SNDA-II (1998-1999) as meals became more consistent with the guidelines, offering greater than one third of the RDAs for all specified nutrients with the exception of calories in middle schools, which was below the targeted recommendation (Fox et al., 2001).

The NSLP gives students the opportunity to learn and practice healthy eating habits. According to a report by Gleason and Suitor (2001a), non-participants are three times as likely to consume sweetened beverages, candy and other sweets, crackers, and high-sodium snacks as NSLP participants. Furthermore, NSLP participants' intake of all assessed micronutrients at school lunch exceeded that of non-participants and significantly exceeded intake of most vitamins and minerals including iron and calcium. However, NSLP participants also exceeded non-participants in intake of total fat, saturated fat, and sodium. It must be noted that this is not representative of total daily micronutrient and macronutrient consumption (Gleason & Suitor, 2001a).

Statement of the Problem

It is important to assess the quality of dietary intake at school lunch among adolescents to ensure adequate intake of essential nutrients and vitamins for optimal growth and development. This project differs from others because it analyzed diet quality at school lunch based on school socioeconomic status (SES). The study examined if there was a difference between quality of food consumption at school lunch between students at low- and middle-SES middle schools.

Hypothesis

There will be no statistical difference in the consumption of the following nutrients and foods between middle school students at a low-SES school and students at a middle-SES school: (a) energy (kcal); (b) protein (g); (c) total fat (g); (d) saturated fat (g); (e) fiber (g); (f) vitamin A (RE); (g) vitamin C (mg); (h) iron (mg); (i) calcium (mg); (j) sodium (mg); (k) fruit/juice (servings); (l) vegetables (servings); (m) high-fat vegetables (servings); (n) milk (fl oz); (o) sweetened beverages, including soft drinks (fl oz); (p) candy (servings); (q) cakes, cookies, etc. (servings); and (r) snack chips (servings).

CHAPTER II

LITERATURE REVIEW

Background

Low-income is categorized as 185% of the federal poverty level or less, and those who qualify for this classification are eligible for food assistance programs through the US government (Knol, Haughton, & Fitzhugh, 2004). Government sponsored school feeding programs focus on the goal of alleviating concerns caused by food insecurity by providing food assistance and meal programs, nutritional education, and nutrition screening, assessment, and interventions for school-aged children and adolescents. The intended outcomes of these programs are optimized physical, cognitive, and social growth and development (Stang & Bayerl, 2003).

Low-income students are likely to participate in government-funded programs including those that provide free or reduced-priced meals. In 1946, the largest child nutrition program was established through the USDA, the NSLP, which now has greater than 30 million student participants (USDA, 2007). This program provides federal reimbursement in the form of cash and commodity foods to public and non-profit private schools and residential childcare institutions. Furthermore, free or reduced-priced meals are available to income qualifying students (FNS, 1998).

The National School Lunch Act requires NSLP schools to adhere to the most recent Dietary Guidelines for Americans, updated in 2005, when planning school menus. The guidelines specify that no more than 30% of calories come from total fat and less than 10% of calories come from saturated fat. Furthermore, the lunches must provide at least one third of the RDA for calories, protein, vitamin A and C, iron, and calcium (USDA, 2007). However, these standards are not applicable to foods or beverages sold outside of the school meal programs such as non-reimbursable *a la carte* items including food from vending machines, school stores, or snack bars (Fox et al., 2001).

The NSLP has come under scrutiny because the SNDA-I conducted in 1991-92 revealed that schools were not serving meals that met the dietary guidelines, particularly with regard to meeting the recommendations for total and saturated fat. Following this study, guidelines for the NSLP were changed to comply with the Dietary Guidelines for Americans. A statistically significant improvement was seen with SNDA-II (1998-1999) as meals became more consistent with the guidelines, offering greater than one third of the RDAs for all specified nutrients with the exception of calories in middle schools, which was below the targeted recommendation (Fox et al., 2001).

The NSLP gives students the opportunity to learn and practice healthy eating habits. According to a report by Gleason and Suitor (2001a), non-participants are three times more likely to consume sweetened beverages, candy and other sweets, crackers, and high-sodium snacks than NSLP participants. Furthermore, NSLP participants' intake of all assessed micronutrients at school lunch exceeded that of non-participants

and significantly exceeded intake of most vitamins and minerals including iron and calcium. However, NSLP participants also exceed non-participants in intake of total fat, saturated fat, and sodium. It must be noted that this is not representative of total daily micronutrient and macronutrient consumption (Gleason & Suitor, 2001a).

Overall Nutritional Status of Adolescents

Poor nutritional health can put children and adolescents at increased risk for acute and chronic diseases as well as educational and social deficits. Short-term problems include growth retardation, iron deficiency anemia, poor academic performance, and development of psychosocial difficulties (Stang & Bayerl, 2003). The long-term consequences include development of type 2 diabetes, cardiovascular disease, cancer, obesity, stroke, and osteoporosis (Nicklas & Johnson, 2004).

Rates of pediatric nutrient deficiency diseases have declined in the US over the past three decades; conversely an increase in childhood obesity and adiposity has been observed (Pilant, 2006). The third National Health and Nutrition Examination Survey (NHANES III) reported that 15.8% of children aged 6-11 years and 16.1% of adolescents aged 12-19 years are overweight (BMI >95th percentile for age and gender) (National Center for Health Statistics, 2004). Childhood adiposity can be correlated with adult morbidity and mortality, as well as create psychological struggles such as poor body image and low self-esteem (Nicklas & Johnson, 2004). An increase in childhood overweight can be attributed to several factors including decreased physical activity and increased caloric consumption.

Food Variety

Overall diet quality is dependent upon the individual foods eaten collectively over time, and MyPyramid presents current guidelines from the USDA for the amount of servings to be eaten from each of the food groups: grain, fruit, vegetable, meat, milk, and fat/sweets. According to a report by Gleason and Suitor (2001a) describing the diets of American school-aged children and adolescents, adherence to the Food Guide Pyramid (the precursor to MyPyramid) was low among American children and adolescents with 2% consuming the recommended minimal number of servings from all food groups, and only 21% of children consuming the recommended amount from any one of the five major food groups.

The Healthy Eating Index (HEI), which is used to assess diet quality, showed that food variety scores did not differ for children based upon food sufficiency, especially among older children with access to food outside the home (Knol et al., 2004). Half of the meals consumed away from home by middle school-aged adolescents are from fast food restaurants resulting in higher intakes of total fat, saturated fat, cholesterol, and sodium, and decreased intakes of fiber, calcium, and iron (Nicklas & Johnson, 2004).

Calories

Total energy intake and energy output are major factors contributing to body weight. Energy dense foods have a high caloric value; however, this does not indicate a high nutrient value. In fact, the increased consumption of energy dense, competitive foods has been associated with a decrease in nutrient density (Templeton, Marlette, &

Panemangalore, 2005). As energy density of foods does not have a great affect on satiety, consumption of larger portion sizes of energy dense foods can substantially increase total daily energy intake (Ello-Martin, Ledikwe, & Rolls, 2005). However, over the past 30 years, the collective NHANES data indicate that the mean daily energy intake of children and adolescents has not significantly changed with the exception of the significantly increased caloric consumption of females aged 12-19 years old (Troiano, Briefel, Carroll, & Bialostosky, 2000).

Fat

The acceptable macronutrient distribution range (AMDR) recommendation for total fat intake of children 4-18 years old is 25-35% of total daily calories (Food and Nutrition Board, 2005). However, the NSLP requires that total fat does not exceed 30 percent of total calories, and saturated fat is less than 10% of total calories for an average school week (FNS, 1998). Restriction of saturated fat is a preventative measure against increased serum total cholesterol and low density lipoproteins (LDL) which are associated with an increased risk of heart disease (National Institutes of Health, 2001). Approximately 75% of school-aged children consumed excess total fat and 84% consumed excess saturated fat in their diets (Gleason & Suitor, 2001a). However, collective NHANES trends indicate that absolute intake of total and saturated fats have not changed significantly over time, and the percentage of calories consumed from total and saturated fats has decreased (Troiano et al., 2000).

Carbohydrate/Fiber/Added Sugar

The AMDR for total carbohydrate intake for children and adults is 45-65% of daily calories (Food and Nutrition Board, 2005). As previously noted, caloric intake and total fat intake have not significantly increased over time, however there has been an increase in carbohydrate consumption (Gleason & Suitor, 2001b). Foods and beverages such as pizza, pasta, Mexican dishes, soft drinks, and fruit juices contribute to the increased intake of carbohydrates. Recommendations for obesity prevention include restricting the consumption of energy dense snacks and sugar-sweetened soft drinks, while increasing consumption of whole grains, fruits, and vegetables (Drewnowski & Specter, 2004). The recommended carbohydrate foods (grains, vegetables, and fruit) contain soluble and insoluble fiber and have an increased nutrient density (Gleason & Suitor, 2001a). Foods containing fiber typically have less fat, cholesterol, and calories. Studies have shown the benefit of fiber on decreasing the risks of cardiovascular disease and improving glycemic control in diabetics (American Dietetic Association, Evidence Analysis Library, n.d.).

The Food and Nutrition Board (2005) recommendation for added sugar is to limit to no more than 25% of total energy. Added sugar includes sugars and syrups added to foods during processing and preparation. They provide extra calories, yet do not contain nutrients. On average, children consume 19.6% total energy from added sugars (Gleason & Suitor, 2001a). Slyper (2004) suggests that the increased consumption of high glycemic index foods, such as those containing added sugars, has been a major contributing factor to the obesity epidemic as they may lead to

hyperinsulinemia and hyperphagia, and sugar-containing drinks like fruit juice and soft drinks may replace other foods resulting in increased overall energy consumption.

Fruit/Vegetables

Fruit and vegetable consumption has been associated with decreased risk of cancer, cardiovascular disease, and other chronic health problems. Increased consumption of fruits and vegetables can assist weight management as they promote satiety due to high water and fiber content yet are not energy dense (Bazzano, 2006).

The previous USDA recommendation for fruits and vegetables was greater than or equal to five servings per day. However, the recommendation changed with the creation of MyPyramid, an interactive, individualized food plan from the USDA replacing the Food Guide Pyramid. MyPyramid recommendations are based on sex, age, and activity level. Currently, the estimated recommendations for females and males between the ages of 9-13 years are 1.5 cups of fruit per day and 2.5 cups of vegetables per day. A specific focus is placed on dark, green leafy vegetables, orange vegetables, and legumes (USDA, n.d.). Only 14% of school-aged children eat the recommended servings of fruit per day, and 17% eat the recommended servings of vegetables per day (Gleason & Suitor, 2001b). Starchy vegetable intake of adolescents is greater than recommended, and intake of dark, green, leafy vegetables, orange vegetables, and legumes is less than one third recommended levels (Guenther, Doss, Reedy, & Krebs-Smith, 2006).

Milk and Dairy

Dairy products are excellent sources of calcium, vitamin D, protein, and magnesium which are beneficial to bone growth and maintenance in children and adolescents. The recommendation for dairy consumption for adolescents is two-to-three servings per day, and the recommended adequate intake (AI) is greater than 1300 mg of calcium per day (Food and Nutrition Board, 2005). Intake of dietary calcium among adolescents is consistently inadequate. On average, 9-13 year old males and females meet 79% and 65% of the AI for calcium, respectively (Storey, Forshee, & Anderson, 2004). Inadequate nutrient intake, emphasizing the importance of calcium and vitamin D intake, is associated with bone loss and increased fracture risk in later life as it impedes the achievement of maximal skeletal growth and bone mineralization, especially in women (Nieves, 2005). Gao, Wilde, Lichtenstein, and Tucker (2006) reported meeting the AI for calcium from a typical American diet was unlikely, if not impossible, without consumption of milk and other dairy products while meeting other nutrient recommendations. However, calcium-fortified food products such as calcium-fortified orange juice and cereals may improve daily calcium intake.

In 1997, Americans drank twice the amount of soft drinks as milk (Nicklas & Johnson, 2004). The increased consumption of sugar-sweetened beverages such as sodas, fruit drinks, and sweetened iced tea parallels the notable obesity epidemic evident in the US. An estimated 54 calories per day per American is received from soft drinks alone (Malik, Schulze, & Hu, 2006). Soft drink consumption not only increases caloric intake, but the replacement of milk with soft drinks along with the high

phosphorus to calcium ratio of sodas increases risk for secondary hyperparathyroidism and bone loss (Nieves, 2005). One study showed that the bone mineral content accrual of females was inversely associated with intake of soft drinks, but the intake of soft drinks does not seem to affect a male's bone mineral content accrual (Whiting et al., 2004).

Sodium

The 2005 Dietary Guidelines for Americans recommend no more than 2300mg of sodium per day for children and adults (United States Department of Health and Human Services, 2005). Studies have convincingly shown that sodium and salt intake among children is greater than recommended, and that sodium intake increases with age (Gleason & Suitor, 2001a; He & MacGregor, 2006). Mean sodium intake among 9-13 year old males and females is 3,553 mg and 2,902 mg per day, whereas mean sodium intake of 14-18 year old males and females is 4,474 mg and 2,933 mg per day, respectively (Gleason & Suitor, 2001a).

The intake of salt affects the regulation of blood pressure in children, and hypertension in later life can be prevented by sustaining normal blood pressure at a young age (He & MacGregor, 2006). The DHHS (2005) reported that 5-10% of dietary sodium comes from adding salt at the table or while cooking, and 75% of dietary sodium comes from processed foods where additional salt is added by the manufacturer. Therefore, reducing consumption of processed foods and increasing consumption of fresh, unprocessed foods will decrease total daily sodium intake.

Factors Influencing Food Choices at School

Participation in school meal programs has declined over the past 20 years; however, it is important to understand the factors that influence students' food choices at school. During school lunch, students have the opportunity to decide which foods they would like to eat from an assortment of entrees, snacks, and beverages. Food may be purchased from tray lines and vending machines or brought from home. Several factors influence food choices at school lunch including the basic environment of the school and cafeteria. Environment includes food availability, food attractiveness, nutrition information displays, nutritional education within the classroom, promotions, and advertisements (Briggs, Safaii, & Beall, 2003; Pilant, 2006). Environment not only influences immediate choices, but may also affect long-term eating patterns and behaviors. Providing high-fat, non-nutritious foods within an affirmative social environment can lead to a positive perception and desire for these foods (Briggs et al., 2003). Participants of the NSLP are more limited in food choices than non-participants. The NSLP requires middle school participants to take full portions of at least three fifths of the specified NSLP meal pattern items being offered; if fewer items are chosen they will be priced individually as *a la carte*, and therefore, not reimbursable (FNS, 1998).

Competitive Foods

Competitive foods are sold independently of the school lunch menu for an additional cost and include vending machine and *a la carte* food items. Competitive foods are not regulated by the USDA Healthy School Meals Nutritional Initiative and are typically minimal in nutritional value. Competitive foods may discourage

participation from and undermine the integrity of nutrition education programs by sending mixed messages to children being taught the value of healthful food choices (Pilant, 2006). Furthermore, competitive foods may contribute to over-consumption of calories, total fat, saturated fat, added sugar, and sodium, while aiding the under-consumption of calcium, fiber, fruit, vegetables, and whole grains (Drewnowski & Specter, 2004).

In 2000, 73.9% of junior high schools had vending machines, school stores/canteens, or snack bars offering a wide assortment of snack foods and beverages (Drewnowski & Specter, 2004). Junior and senior high schools are able to fund extracurricular activities and compensate for budget shortfalls by signing contracts with corporations that provide vending machines (Stein, 2005). Arising concerns from these contracts include brand name advertising that may be targeted at children and other low-income consumers, large corporations taking advantage of under-funded schools, and the negative financial impact of removing established vending machines from the school (Stein, 2005). Many school nutritional services are expected to be financially independent; therefore, options revolve around offering competitive food items or increasing the price of school meals (Briggs et al., 2003). Fortunately, some companies are responding to the shift in demand for more nutritious alternatives (Stein, 2005).

Nutrition Education

Greater than 95% of all children in the US between the ages of 5 and 17 attend school; therefore, from a nutritional standpoint, schools and communities have the responsibility of providing students with high-quality, affordable food as well as

nutritional education (Briggs et al., 2003). Education and knowledge can influence action and behavior; therefore, healthful habits established at a young age may persist as lifelong behaviors (Stein, 2005). Nutritional education should promote energy balance, moderation, and healthy eating patterns consistent with federal dietary and nutritional guidelines (Nicklas & Johnson, 2004). Approximately 13 hours per school year are spent on nutrition education, although 50 hours are recommended to impact behavior (Briggs et al., 2003). In 2003, 61% of schools in the US lacked a coordinated nutrition education program. Consequently, teachers have been asked to integrate nutrition and health education into lesson plans, but amidst budget cuts and being provided outdated, poorly evaluated curricula, teachers are inadequately prepared to deliver effective, evidence-based education concerning health needs (Stein, 2005). Education strongly influences healthy diet practices; however age and income also have a significant impact (Drewnowski & Specter, 2004).

Dietary Intake and SES

At the beginning of the century, 10 million households in the US, or 9.7% of all US households, claimed to be food insecure. Food insecurity is defined as "limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire foods in socially acceptable ways" (Nord et al., 1999, p. 2). Risk of food insecurity is increased in households with children, single-parent households where the family head has less than 12 years of education, and households that do not have health insurance (Drewnowski & Specter, 2004). Food insecurity can be associated with developmental delays in early childhood as Jyoti et al. (2005, p. 2835)

reported "...impaired academic performance in reading and mathematics for boys and girls, decreased social skills for boys, and greater weight gain and BMI gains for girls."

Many health disparities trend toward poor education and income. In the US, obesity and type 2 diabetes trail a socioeconomic decline as those with limited resources, of ethnic minorities, and low-income classification tend to markedly develop these diseases (Drewnowski & Specter, 2004). Low-SES neighborhoods are associated with an increased risk of obesity due to the poor availability of healthy, nutrient dense food (Wang, Kim, Gonzalez, MacLeod, & Winkleby, 2007). However, this trend does not necessarily apply to the children of food insecure homes. Overweight status among food insecure children is 20% less likely than food secure children, and children from minority families, especially Latino boys and black girls, are more likely to be overweight than White boys and girls (Rose & Bodor, 2007).

Poverty and food insecurity are associated with lower food expenditure, decreased fruit and vegetable consumption, and lower quality diet (Drewnowski & Specter, 2004). Food costs can be a barrier to dietary change and may negatively affect diet quality.

There is an inverse relationship between energy density and energy cost. Those who are classified as food insecure typically have adequate daily caloric intake but a limited range of food options. Advanced technology has provided lower cost food items, which are generally energy dense, shelf-stable, and made with refined grains, added sugar, and added fat. The consumption of these foods is reinforced by the increased palatability of sugar and fat. Conversely, high cost food items are typically

perishable and include fresh foods such as meats, fish, and fresh fruits and vegetables (Drewnowski & Specter, 2004). A study by Moore and Diez Roux (2006) showed that the local food environments of poorer areas and non-White areas tend to have fewer fruit and vegetable markets, bakeries, specialty stores, and natural food stores. Instead, these neighborhoods have a greater number of liquor stores and small grocery stores which offer less variety of nutritionally superior products.

CHAPTER III

METHOD

Participants

The study groups consist of approximately 6,000 sixth, seventh, and eighth grade students attending one of two middle schools in Harris County, Texas. The schools represent low- and middle-SES as classified by percentage of students participating in the NSLP receiving free/reduced-price lunches. The low-SES school contains 80% free/reduced-price lunch participants, and the middle-SES school contains 40% free/reduced-price lunch participants.

Procedure

This study utilized data from a larger study completed at the Children's Nutrition Research Center of the Baylor College of Medicine entitled "Evaluation of the Texas School Food Policy," which was approved by the Institutional Review Board at Baylor College of Medicine (see Appendix A). The students' guardians were informed about the study in a letter sent home with the students, written in English and Spanish, and notified that their child could assent or refuse to provide anonymous lunch consumption data.

Lunch Food Records

The middle schools were visited weekly for the school year of 2005-2006. A trained data collector attended lunch for each grade level and would select one or two

tables of students and ask them to complete an anonymous food record immediately after eating, which maximized accuracy of report (Baxter, Thompson, Davis, & Johnson, 1997). The students were given the option to assent or refuse to participate in the study. With the provided student assent, the trained data collector explained how to record food consumption: listing each food on a separate line, indicating how many servings were eaten, and identifying the source of each food (school tray lunch, snack bar, home, vending, other source). Previous research has validated this method of food record data collection (Domel et al., 1994). Pencils were given to students who took part in the study to further encourage participation.

Food Record Analysis

Nutrition Data Systems (NDS: version 4.2; Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN, USA) was used to acquire energy, nutrients, and servings of food, using algorithms developed in a previous study (Cullen et al., 2004). The USDA has set specific required nutrient standards for the traditional NSLP meal pattern; therefore, the following nutrients were obtained from the NDS analysis: (a) energy (kcals); (b) protein (g); (c) total fat (g); (d) saturated fat (g); (e) fiber (g); (f) vitamin A (RE); (g) vitamin C (mg); (h) iron (mg); (i) calcium (mg); and (j) sodium (mg). Servings of the following food groups were also obtained from NDS: fruit/juice, vegetables, high-fat vegetables, milk (oz), sweetened beverages including soft drinks (oz), candy, cakes and pies, and snack chips.

Statistical Analyses

Demographics

Descriptive statistics were utilized to categorize participants by grade level, gender, and ethnicity.

Hypothesis Test

The frequency and overall mean intakes of nutrients and food groups listed previously in the hypothesis section were obtained from the NDS analysis of the students' individual lunch records from the 2005-2006 school year. Individual t-tests for the previously specified subsets of nutrients and food groups were utilized to determine if there was a statistical difference between the quality of lunch consumption between students at low- and middle-SES middle schools. SPSS was used to analyze the data, and the significance level was set at $< .05$.

Overall meal quality was evaluated by comparing consumption of the specified subsets of nutrients and food groups to the NSLP guidelines utilizing descriptive statistics, assessing whether or not the standards were being met from lunches consumed at low- and middle-SES schools.

CHAPTER IV

RESULTS

In the 2005-2006 school year, 6,756 lunch records were completed by students at the participating low- and middle-SES middle schools. These lunch records were included for data analysis (see Table 1). The study sample consisted of sixth, seventh, and eighth grade students; 3,877 (57%) were male and 2,879 (43%) were female. Three fourths of the total participants were Hispanic; however, ethnicity distribution varied by the SES of the school. The participants from the low-SES school were primarily Hispanic (93.2%), while the middle-SES school had 59.4% Hispanic and 30.8% White participants. Black and Asian/other ethnicities represented 7.3% of the participants at both schools.

Table 1

Demographics of Student Participants

	Low-SES Participants[a]	Middle-SES Participants[b]	Total Participants
	Frequency (%)	Frequency (%)	Frequency (%)
Grade			
6	1155 (36.4%)	1492 (41.6%)	2647 (39.2%)
7	1052 (33.2%)	1317 (36.7%)	2369 (35.1%)
8	962 (30.3%)	774 (21.6%)	1736 (25.7%)
Gender			
Male	2,089 (65.9%)	1788 (49.9%)	3877 (57.4%)
Female	1081 (34.1%)	1798 (50.1%)	2879 (42.6%)
Ethnicity			
Hispanic	2954 (93.2%)	2131 (59.4%)	5085 (75.3%)
White	72 (2.3%)	1103 (30.8%)	1175 (17.4%)
Black	46 (1.5%)	123 (3.4%)	169 (2.5%)
Asian/Other	98 (3.1%)	224 (6.2%)	322 (4.8%)

Note. $N = 6{,}756$. SES = socioeconomic status.

[a]$n = 3{,}170$. [b]$n = 3{,}586$.

The NDS analysis of the students' individual lunch records for nutrient consumption (mean intake and *SD*) is presented in Table 2. The students at the low-SES school had reported significantly higher intakes of protein (28.4 ± 10.7 g) and calcium (481 ± 276 mg) than students at the middle-SES school (27.2 ± 11.9 g protein and 435 ± 295 mg calcium) ($p < .01$). The students at the low-SES school also reported significantly higher intakes of vitamin A (229 ± 154 RE) and vitamin C (27.8 ± 31.8 mg) than students at the middle-SES school (206 ± 164 RE vitamin A and 24.5 ± 30.4 mg vitamin C) ($p < .01$). However, middle-SES school students reported significantly higher intakes of energy (722 ± 243 kcals), total fat (28.1 ± 12.7 g), and iron (4.0 ± 1.9 mg) than low-SES school students (694 ± 238 kcals, 26.6 ± 11.4 g total fat, and 3.9 ± 1.8 mg iron). There was no statistically significant difference in the reported consumption of saturated fat, dietary fiber, and sodium between the low- and middle-SES school students. However, not all values met the NSLP guidelines as will be discussed below.

Table 2

Mean Nutrient Consumption at School Lunch Based on SES

	Low-SES Participants	Middle-SES Participants
	Mean (*SD*)	Mean (*SD*)
Nutrients		
Energy (kcal)**	694.0 (238)	722.0 (243)
Protein (g)**	28.4 (10.7)	27.2 (11.9)
Total fat (g)**	26.6 (11.4)	28.1 (12.7)
Saturated fat (g)	10.4 (5.2)	10.3 (5.7)
Dietary fiber (g)	5.2 (3.2)	5.1 (3.1)
Vitamin A (RE)**	229.0 (154)	206.0 (164)
Vitamin C (mg)**	27.8 (31.8)	24.5 (30.4)
Iron (mg)*	3.9 (1.8)	4.0 (1.9)
Calcium (mg)**	481.0 (276)	435.0 (295)
Sodium (mg)	1243.0 (556)	1242.0 (580)

Note. Individual t-tests were performed to determine statistical difference. SES = socioeconomic status, kcal = kilocalories, g = grams, RE = retinol equivalent, mg = milligrams.

*$p < .05$. **$p < .01$.

The NDS analysis of reported student consumption of servings of various food groups (mean intake and *SD*) is presented in Table 3. The students at the low-SES school reported significantly greater consumption of milk (7.09 $\pm$ 5.39 fl oz) and significantly less consumption of sweetened beverages (1.02 $\pm$ 3.49 fl oz) than the middle-SES school students (5.76 $\pm$ 5.61 fl oz milk and 2.21 $\pm$ 5.17 fl oz sweetened beverages) ($p < .01$). The low-SES students also reported consuming significantly more servings of fruit/juice (0.42 $\pm$ 0.56) than the middle-SES school students (0.35 $\pm$ 0.57) ($p < .01$); however there was not a significant difference in reported vegetable consumption between the groups. Lastly, low-SES students reported consuming significantly fewer servings of candy, cakes, and snack chips than the middle-SES school students. Therefore, hypotheses a, b, c, f, g, h, i, k, n, o, p, q, and r are rejected.

Table 3

Mean Servings of Food Groups Consumed at School Lunch Based on SES

	Low-SES Participants	Middle-SES Participants
	Mean (*SD*)	Mean (*SD*)
Food Groups		
Fruit/juice**	0.42 (0.56)	0.35 (0.57)
Vegetables	0.91 (1.12)	0.87 (1.23)
High fat vegetables	0.13 (0.40)	0.13 (0.40)
Milk (fl oz)**	7.09 (5.38)	5.76 (5.61)
Sweetened beverages (fl oz)**	1.02 (3.49)	2.21 (5.17)
Candy**	0.01 (0.10)	0.07 (0.22)
Cakes**	0.01 (0.07)	0.07 (0.30)
Snack chips**	0.02 (0.21)	0.07 (0.31)

Note. Individual t-tests were performed to determine statistical difference. SES = socioeconomic status, fl oz = fluid ounces.

*$p < .05$. **$p < .01$.

Overall meal quality was evaluated by comparing the mean dietary intake of student participants at school lunch to the nutrients and food groups specified by the NSLP guidelines (see Table 4). The nutritional content of the lunches consumed by the students participating in this study did not meet the majority of the NSLP guidelines. The overall mean energy intake was inadequate. The students' reported energy consumption (709 kcals) met 85.9% of the NSLP guideline (825 kcals) to provide one third of the daily caloric recommendation for this particular age group. Furthermore, while overall intake of total fat met the NSLP guideline, intake of saturated fat (10.4 g) exceeded the guideline (< 9.2 g).

Both the low- and middle-SES school students exceeded the NSLP calcium recommendation; however, students at neither school met the recommended eight fluid ounces of milk at lunch (reported consumption was 7.09 fl oz for low-SES and 5.76 fl oz for middle-SES students). Neither did they meet the recommendation of two servings of fruits/vegetables at lunch. Although intake of vitamin A was significantly greater for low-SES students (229 $\pm$ 154 RE) than middle-SES students (206 $\pm$ 164 RE), overall mean intake of vitamin A (217 RE) met only 72.3% of the NSLP standard (300 RE). Similarly, overall intake of iron (3.9 mg) only met 86.7% of the NSLP recommendation (4.5 mg).

Table 4

NSLP Guidelines Compared to Overall Mean Intake of Student Participants

	NSLP Standard	Mean Intake of Middle School Students
Nutrients		
Energy (kcal)	825	709
Protein (g)	16	27
Vitamin A (RE)	300	217
Vitamin C (mg)	18	26
Iron (mg)	4.5	3.9
Calcium (mg)	400	456
Total fat (g)	≤ 27.5	27.4
Saturated fat (g)	< 9.2	10.4
Food Groups		
Fruit/Vegetable (servings)	2.0	1.4
Milk (fl oz)	8.0	6.4

Note. NSLP = National School Lunch Program, kcal = kilocalories, g = grams, RE = retinol equivalent, mg = milligrams, fl oz = fluid ounces.

CHAPTER V

DISCUSSION

Although extensive research has been done looking at the quality of school lunches in American high schools and middle schools, no research was found that looked at the quality of school lunch consumed by students based on SES. The purpose of this study was to determine if there was a significant difference in the consumption of the specified nutrients and foods between middle school students attending low- and middle-SES schools.

Nutrient and Food Group Consumption

A significant difference was observed in the nutrient and food group intake for several categories between students at low- and middle-SES schools. These differences may be related to the nutrient content of school lunches that must abide by NSLP guidelines for free/reduced-price lunches verses lunches brought from home. The NSLP provides free/reduced-price lunches to students who are at or below the poverty level and requires participating schools to serve lunches that provide no more than 30% of calories from total fat over a school week and less than 10% of calories from saturated fat over a school week. Furthermore, the lunches must provide at least one third of the RDA for calories, protein, vitamin A and C, iron, and calcium (USDA, 2007). In this study, the low-SES school contained 80% free/reduced-price lunch participants, and the middle-SES school contained 40% free/reduced-price lunch

participants. Research by Delva, O'Malley, and Johnston (2007) showed a negative linear relationship between SES and likelihood of eating the lunches offered by the school, and a positive linear relationship between SES and students who brought their lunch to school. Therefore, low-SES students would be more likely to receive daily lunches that are nutritionally regulated. Providing these nutrients to low-SES students at school is especially important because poverty and food insecurity are associated with overall lower food expenditure, decreased fruit and vegetable consumption, and lower quality diet (Drewnowski & Specter, 2004).

The students at the middle-SES school reported significantly greater ($p < .01$) intake of sweetened beverages, candy, cakes, and snack chips than those at the low-SES school. According to Delva et al. (2007), there was not significant difference in the provision of *a la carte* items or types of *a la carte* items offered by SES with the exception of low fat snack options (salty snacks, baked goods, ice cream, yogurt, etc.) offered in the cafeteria at lunch. Therefore, it may be possible that students attending higher-SES schools have more discretionary spending than students at low-SES schools, providing higher-SES students greater opportunity to purchase competitive foods and foods of minimal nutritional value. Templeton et al. (2005) found that students consuming competitive foods at school lunch had significantly greater intakes of energy, total fat, and saturated fat; they also had greater plate waste resulting in less consumption of calcium and vitamin A.

Overall Meal Quality Compared to the NSLP Guidelines

The nutritional analysis of the lunches consumed by the students participating in this study showed that they did not meet all of the NSLP guidelines. As noted previously, the low-SES schools had significantly greater intake of many of the specified nutrients and food groups; however they did not always meet the standards set by the NSLP. Therefore, students at both low- and middle-SES schools are failing to meet overall nutritional expectations for school lunches.

Students did meet the NSLP guidelines for protein, total fat, vitamin C, and calcium. In fact, both low- and middle-SES schools exceeded the NSLP calcium recommendation; however, neither school met the recommended eight fluid ounces of milk at lunch. This may be occurring because only eight fluid ounces are served to the student, and he/she may not finish the entire serving; while other sources of calcium such as cheese and yogurt may be available in the school lunch.

The inadequate energy and excessive saturated fat intakes of students in this study are consistent with the School Nutrition and Dietary Assessment - II performed in 2001 finding similar results among lunches served in secondary schools (Fox et al.).

Inadequate intake of fruit/vegetables at school lunch is consistent with a previous report from the USDA (Gleason & Suitor, 2001a). The NSLP requires students to take three-to-five menu items at lunch. One item must be an entrée and another must be fluid milk. Therefore, if a NSLP participant chooses the minimal number of menu items, it would be impossible to meet the recommended two servings of fruit/vegetables at lunch. The inadequate intake of fruit/vegetables may also be

affecting the intake of vitamin A and iron, which was also found to be inadequate in these middle school students. The availability of these nutrients could be improved for both school prepared lunches and lunches prepared at home by providing more fruit/vegetables that are consistent with the MyPyramid guidelines, specifically focusing on dark, green leafy vegetables, orange vegetables, and legumes (USDA, n.d.). However, it would still be the student's responsibility to choose and consume the food.

Limitations

These data are representative of nutritional intake at school lunch and do not provide information on the total daily nutrient intake of students based on SES. One cannot generalize from this study that either of the student groups is or is not meeting the DRIs based on the finding that low-SES students have more acceptable nutrient intake than middle-SES students at school lunch.

Another limitation of this study was the use of self-reporting of dietary intake. Although previously validated procedures were used to maximize the accuracy of report, such as using trained data collectors to help and monitor the students and recording food intake immediately after eating, it is still possible that misreporting occurred.

Lastly, the cross-section of ethnicities represented in this study may not be generalized to the US as a whole. The majority of the student population represented by this study was Hispanic; however, it should be noted that 41.9% of the population in Houston, Texas is Hispanic (United States Census Bureau, 2006). Although the Hispanic population has continued to grow in America, it is possible that other states

would not have a similar demographic distribution amongst low- and middle-SES middle schools. The lesser representation of White, Black, and Asian/other students was consistent with the ethnicity demographics of this particular Harris County school district. Other school districts within Harris County have varied ethnic representation as compared to the sample district (Texas Education Agency, 2007).

CHAPTER VI

CONCLUSIONS AND IMPLICATIONS FOR FUTURE RESEARCH

This study found that there is a difference between quality of food consumption at school lunch between students attending low- and middle-SES middle schools. The low-SES school, which had a greater number of students qualifying for NSLP, reported school lunch consumption that provided significantly greater protein, vitamin A, vitamin C, and calcium, and significantly less energy, total fat, and iron than the middle-SES school students. Low-SES school students also consumed fewer foods of minimal nutritional value than middle-SES school students. However, students at both low- and middle-SES schools are failing to meet overall nutritional expectations for school lunches set by NSLP guidelines.

Little research has been done to look at the quality of school lunch based on SES, and further research is recommended to examine if these findings may be generalized to all grade levels and to different geographic and cultural regions of the US. Also, it is important to ensure adequate intake of essential nutrients and vitamins for optimal growth and development during childhood and adolescence. Future research should investigate methods to improve food choices and consumption by students at school lunch.

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APPENDIX

Institutional Review Board Approval Forms

August 11, 2005

BCM
Baylor College of Medicine

KAREN W CULLEN
BAYLOR COLLEGE OF MEDICINE
PEDIATRICS: NUTRITION

Baylor College of Medicine
Office of Research
One Baylor Plaza, 600D
Houston, Texas 77030
Phone: (713) 798-6970
Fax: (713) 798-6990
Email: irb@bcm.tmc.edu

H-16622 - EVALUATION OF THE TEXAS SCHOOL FOOD POLICY ON STUDENT CONSUMPTION

APPROVAL VALID FROM 8/11/2005 TO 8/11/2006

Dear Dr. CULLEN

The Institutional Review Board for Human Subject Research for Baylor College of Medicine and Affiliated Hospitals (BCM IRB) is pleased to inform you that the research protocol named above was approved.

The study may not continue after the approval period without additional IRB review and approval for continuation. You will receive an email renewal reminder notice prior to study expiration; however, it is your responsibility to assure that this study is not conducted beyond the expiration date.

Please be aware that only IRB-approved informed consent forms may be used when written informed consent is required.

Any changes in study or informed consent procedure must receive review and approval prior to implementation unless the change is necessary for the safety of subjects. In addition, you must inform the IRB of adverse events encountered during the study or of any new and significant information that may impact a research participants' safety or willingness to continue in your study.

The BCM IRB is organized and operated according to guidelines of the International Council on Harmonization , the United States Office for Human Research Protections and the United States Code of Federal Regulations and operates under Federal Wide Assurance No. 00000286, issued April 30, 2001. Affiliated hospitals include: the Veterans Affairs Medical Center, The Methodist Hospital, Texas Childrens Hospital, Texas Institute for Rehabilitation and Research, and the Harris County Hospital District.

Sincerely yours,

LAUREN MARANGELL, M.D.
Institutional Review Board for Baylor College of Medicine and Affiliated Hospitals

Association for the Accreditation of Human Research Protection Programs, Inc.
Full AAHRPP Accreditation

BCM

Baylor College of Medicine

DATE: 3/28/08

TO: Ashley Fithian

FROM: Karen W. Cullen, DrPH, RD, LD *KWC*

RE: Use of Data

This letter is written as permission for Ashley Fithian to analyze the data collected from my project for her thesis. The data set does not include personal identifiers beyond project identification numbers.

The data sets were collected with the approval of the Institutional Review Board of Baylor College of Medicine.

TWU
TEXAS WOMAN'S UNIVERSITY
DENTON DALLAS HOUSTON

Office of Research
6700 Fannin Street
Houston, TX 77030-2343
713-794-2480 Fax 713-794-2488

April 15, 2008

Ms. Ashley Fithian
Nutrition&Food Services - Karen Moreland Faculty Advis
6700 Fannin Street
Houston, TX 77030

Dear Ms. Fithian:

Re: "Quality of dietary intake at school lunch of middle school students based on socioeconomic status"

The above referenced study has been reviewed by the TWU Institutional Review Board (IRB) and was determined to be exempt from further review.

Any changes in the study must receive review and approval prior to implementation unless the change is necessary for the safety of subjects. In addition, you must inform the IRB of adverse events encountered during the study or of any new and significant information that may impact a research participant's safety or willingness to continue in your study.

Sincerely,

William P. Hanten

Dr. William P. Hanten, Chair
Institutional Review Board - Houston