THE CONTRIBUTION OF SCHOOL MEALS TO THE DAILY INTAKE OF LOW INCOME CHILDREN AND ASSOCIATIONS WITH AGE, GENDER AND ETHNICITY

A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF A MASTER OF SCIENCE

IN THE GRADUATE SCHOOL OF THE

TEXAS WOMAN'S UNIVERSITY

COLLEGE OF HEALTH SCIENCES
TEXAS WOMAN'S UNIVERSITY

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DENTON, TEXAS
DECEMBER 2015

ACKNOWLEDGEMENTS

I would like to acknowledge those who have helped me complete this process. Thank you to my committee members for their advice and efforts in helping me compile the thesis into its final product. Thank you Dr. Cullen for providing the data for this study and for always being available for questions and never failing to provide a swift response. I would also like to thank you for working with me over the summer to help speed the process. Thank you Dr. Moore for agreeing to chair the thesis committee and taking the time out of your already busy schedule to assist me in editing and writing my thesis. I am also thankful to Dr. Cynthia Warren for agreeing to sit on the committee and providing helpful feedback. Lastly, thank you to my family and friends who were always supportive of my decision to return to school and pursue a career in nutrition.

ABSTRACT

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THE CONTRIBUTION OF SCHOOL MEALS TO THE DAILY INTAKE OF LOW INCOME CHILDREN AND ASSOCIATIONS WITH AGE, GENDER AND ETHNICITY

DECEMBER 2015

Diet trends and energy intake in the United States have changed over recent decades. The purpose of this study was to assess the contribution of school meals to total dietary intake of low income children and to observe whether there are differences by gender, ethnicity, and age. Participants were between the ages of 9 and 12 years old and were children in the after school programs at four different Houston area Boys and Girls Clubs. Although there were slight variations, findings indicated that there were no significant differences in the contribution of school meals to daily intake and food groups when compared by age, gender, and ethnicity.

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CHAPTER I

INTRODUCTION

Statement of the Problem

Diet trends in the United States (U.S.) have changed over recent decades. The consumption of salty snacks, desserts, soft drinks, fruit drinks, French fries, burgers, pizzas and Mexican fast foods has significantly increased in children from families of lower socioeconomic status (SES) when dietary recalls are compared from 1977-1978 to 2003-2006 (Piernas & Popkin, 2011).

Along with a high consumption of unhealthy foods, fruit and vegetable consumption is below recommendations for children, especially those of lower SES (Robinson-O'Brien et al., 2010). In 2000, the estimated mean daily intake of fruits and vegetables for children between the ages of 9 and 13 was 3.7 servings per day in comparison to the recommended intake of at least 5 servings per day (USDA, 2010).

The National School Lunch Program (NSLP) was created in 1946 to address the consequences of poor nutrition in U.S. children. The program preceded the School Breakfast Program and many others that followed it. For decades school meal programs have provided children, particularly low income children, with a healthy meal. Revised guidelines continue to provide a healthy meal pattern for all students.

Purpose of the Study

The purpose of this study was to examine the contribution of school meals to the daily intake of low income children, observing whether there were differences by age, gender, and ethnicity. The goal was to better understand the contribution of school meals to a higher risk population.

Hypotheses

The null hypotheses for this study were as follows:

- H1. The mean amounts and percent contribution of energy and food groups consumed at school did not differ by gender.
    - H1a. The mean amounts of energy consumed at school did not differ by gender.
    - H1b. The mean amounts of food groups consumed at school did not differ by gender.
    - H1c. The percent contribution of energy from school meals to daily intake did not differ by gender.
    - H1d. The percent contribution of food groups from school meals to daily intake did not differ by gender.
- H2. The mean amounts and percent contribution of energy and food groups consumed at school did not differ by age.

    - H2a. The mean amounts of energy consumed at school did not differ by age.
    - H2b. The mean amounts of food groups consumed at school did not differ by age.
    - H2c. The percent contribution of energy from school meals to daily intake did not differ by age.
    - H2d. The percent contribution of food groups from school meals to daily intake did not differ by age.
- H3. The mean amounts and percent contribution of energy and food groups consumed at school did not differ by ethnicity.
    - H3a. The mean amounts of energy consumed at school did not differ by ethnicity.
    - H3b. The mean amounts of food groups consumed at school did not differ by ethnicity.
    - H3c. The percent contribution of energy from school meals to daily intake did not differ by ethnicity.
    - H3d. The percent contribution of food groups from school meals to daily intake did not differ by ethnicity.

CHAPTER II

LITERATURE REVIEW

Trends in Nutrition Status of Children of Low Income Families

Diet trends and energy intake in the U.S. have seen changes over recent decades. Comparing diet trends of individuals in 1989 to 2010, it is troubling that preschool children aged two to five years old and children of low income families had higher total energy intake than any other population. Findings indicate energy intake among these populations was greater than twenty years ago (Slining, Mathias & Popkin, 2013). Higher total energy intake may be related to increased portion sizes, and more frequent eating occasions, as well as increased access to restaurants and food sources away from home.

During the 2009-2010 school year, school aged children consumed an average of 3,279 mg of sodium a day (MMWR, 2014). This level of sodium intake indicates that over 90% of school-aged children and adolescents consumed high levels of sodium. Nearly half of the daily sodium intake of children came from pizza, bread, cold cuts or cured meats, savory snacks, sandwiches, cheese, chicken patties or nuggets, pasta dishes, Mexican mixed dishes, and soups. The highest contributor to sodium intake was store bought foods. School foods contributing only 9% of the daily sodium intake according to the Daily Recommended Intake (DRI) levels (Centers for Disease Control, 2010). A higher

proportion of sodium came from school meals in elementary students when compared to middle school and high school students. However, those children who qualified for free or reduced-priced lunch showed lower sodium intakes from school meals compared to those students of middle or higher income. If these trends continue, it is estimated that one in six U.S. children between the ages of eight and 17 years old could develop pre-high blood pressure or high blood pressure due to the higher intake of sodium (MMWR, 2014).

The intake of solid fats and added sugars decreased among children ages 2-18 years old when comparing dietary habits of 1994 to 2010 (Slining & Popkin, 2013). The percentage of solid fats and added sugars in diets declined from 39% in 1994-1998 to 33% in 2009-2010. However, these percentages still exceeded recommended values by as much as 28% and contributed to total energy intake. While the decline is positive, it is important to note that among children ages two to five years old, there was no decrease in the percentage of total energy intake from solid fats and added sugars. The largest sources of added sugars were sugar-sweetened beverages, grain-based desserts, candy, ready-to-eat cereals, dairy-based desserts, sweeteners and syrups. The greatest contributors to solid fat intake included grain-based desserts, pizza, cheese, processed meats, and fried potatoes. These solid fat items contributed differently to percent energy intake according to ethnicity and income level. Lower income children and

Mexican American children consumed more tortilla and corn-based dishes contributing more to their solid fat intake (Slining & Popkin, 2013).

Access to food sources among families of low SES has been shown to impact diet habits and overall health. Among low SES families of Texas Border communities, a greater distance to the nearest convenience store was related to a decrease in total energy intake, vitamin D, total sugar and added sugars, total fat and saturated fat (Sharkey, Dean, Nalty & Xu, 2013). Factors that impacted dietary habits of low income families included access to convenience stores or traditional grocery stores. The term “food desert” has become widely known in the U.S. and is defined by the United States Department of Agriculture (USDA) as encompassing regions greater than one mile from a supermarket in urban and suburban areas and greater than 10 miles from a supermarket in rural regions (Frndak, 2014). Convenience stores typically would not be considered a supermarket. The USDA considers supermarkets to be facilities that sell all major food groups with annual sales of at least two million dollars. It is estimated that 23.5 million low income families live in food deserts. The limited access to food puts children and families of low SES and those living in food deserts at a greater risk for poor nutrition.

Low SES and a number of other factors contribute to a rise in obesity due to limited access to nutritious foods among American children and adolescents (Kant & Graubard, 2013). Children from families of low SES and lower education

are more likely to have a higher Body Mass Index (BMI). One study found that children from persistently low income families were more likely to remain overweight (Demment, Haas & Olson, 2014). Children whose family moved into low income areas also had a higher likelihood of becoming obese. Interestingly, the prevalence of obesity increased in all boys between 1999-2000 and 2009-2010 but did not increase among girls (Ervin & Ogden, 2013). Children and adults of low income families often chose foods with higher energy density, rather than nutrient density, which can lead to a positive energy balance (Kant & Graubard, 2013). A stronger correlation is also seen with a lack of education which is often associated with low income, emphasizing the importance of nutrition education among children. Children of low income families with poor access to food sources have shown lower achievement scores in school which could inhibit a child's prospects of a higher education, suggesting that education as well as proper nutrition are both important factors in the success of a child (Frndak, 2014).

When assessing diet trends over 30 years and its relation to SES and education, individuals with higher education were less likely to skip breakfast and reported a lower incidence of eating unhealthy snacks (Kant & Graubard, 2013). This observation suggests that education plays a role in overcoming societal factors that may impact nutrition habits. Individuals of lower SES who were educated on nutrition choices were more likely to pick foods based on nutritional

value rather than those individuals who were not educated on better nutrition choices. Their children were more likely to purchase more energy dense foods (Kant & Graubard, 2013).

Improvements in nutrient density of children's intake may be achieved through the National School Lunch Program (NSLP) and the School Breakfast Program (SBP). Low income children who participated in the NSLP were more likely than nonparticipants to have an adequate usual daily intake of vitamin A, vitamin B6, vitamin B12, folate, niacin, riboflavin, thiamin, iron, phosphorus, and zinc (USDA, 2008). National Health and Nutrition Examination Survey (NHANES) data from 1999-2004 found that low income NSLP participants were more likely to consume all three meals each day, whereas nonparticipants typically had one less meal than their counterparts (USDA, 2008). Lunches consumed by low income NSLP participants were filled with more nutrient-dense foods; higher-income NSLP participants' lunches were also filled with more nutrient-dense foods (USDA, 2008).

Trends in Nutrition Status of Children by Race and Ethnicity

Large portion sizes have contributed to an increase in excess energy intake and obesity among low-income Hispanics and African American children (Piernas & Popkin, 2011). Based on findings of the 2011-2012 NHANES, approximately 17% of American children ages 2-19 were obese and 31% were considered overweight (Ogden, Carroll, Kit, & Flegal, 2014). Child obesity trends

indicated that non-Hispanic blacks and Mexican Americans were more likely to have a higher adiposity than non-Hispanic whites (Dodd et al., 2013). Not only were obesity rates higher among Mexican Americans, obesity and overweight status was higher among Hmong adolescent males than non-Hispanic white adolescent males (Arcan et al., 2014). The Hmong ethnicity represents those who are decedents from the mountainous regions of China, Thailand, Vietnam, and Laos.

Changes in dietary habits are a significant contributor to the rising problem of obesity in minority groups. In food desserts of Texas border communities, children are often allowed to purchase their own food from nearby convenience stores, a contributing factor to higher levels of total energy intake, total fat, and saturated fat intake (Sharkey, Dean, Nalty & Xu, 2013). Among non-Hispanic blacks and Mexican Americans, the amount of nonnutritive beverages and its contribution to daily overall intake has risen significantly (Kant & Graubard, 2011). In 2005, approximately 75% of children in school were drinking at least one sugar sweetened beverage each day (Dodd et al., 2013). The percentage was higher for high school students and milk consumption significantly declined compared to younger students in middle school and elementary school. Mexican American children consumed more sweetened milk and flavored or sweetened coffees and teas than non-Hispanic whites and those from middle income families (Slining & Popkin, 2013). A Minnesota-based study found that the

consumption of sugar sweetened beverages was lowest amongst the Hmong population in comparison to non-Hispanic whites and other minorities while the consumption of energy drinks was highest in Somali boys (Arcan et al., 2014). The Hmong children reported the lowest fruit and vegetable intake whereas Hispanic and Somali boys and girls had a higher fruit intake than their non-Hispanic white peers.

The frequency of drinking milk at home significantly decreased in non-Hispanic blacks as the child aged (Dodd et al., 2013). Among females, Hispanic, Hmong, and Somali girls showed a lower milk consumption than non-Hispanic white female children (Arcan et al., 2014). Thus, discouraging the consumption of sugar sweetened beverages at an early age may help decrease the discrepancies in obesity among ethnicities.

Fast food intake is higher in Hispanics, and diet recalls of one study indicated that Hispanic children consumed fast food more than three times per week, which was higher than non-Hispanic whites (Arcan et al., 2014). High consumption of fast foods could be significant when considering that Hispanics children have highest rates of obesity.

Breakfast is associated with beneficial dietary habits and has been proven to enhance cognitive functioning and plays a role in the maintenance of a healthy weight, making it an important meal of the day (Arcan et al., 2014). Amongst the Hmong, Somali, and Hispanic minorities, Hmong boys infrequently consume

breakfast which is also true for non-Hispanic whites (Arcan et al., 2014). Somali boys have the highest breakfast intake compared to non-Hispanic whites and the Hmong and Hispanic minorities

Overall, the nutritional value of diets of minority children is a concern. However, the diets of all ethnicities studied, including non-Hispanic whites, were low in fruit, vegetables, and milk intake and higher in fast food and sugar sweetened beverages though the amounts were significantly higher amongst minorities (Arcan et al., 2014).

Though these minority groups exist today in conjunction with a majority non-Hispanic white population, the ethnic lines concerning minority and majority are slowly merging. In 1960, 85% of the U.S. population identified as non-Hispanic white (Pew Research Center, 2015). By 2060, it is estimated that only 43% of the U.S. population will identify as non-Hispanic white. From 1960 to 2010, those who identified as non-Hispanic black, Hispanic, Asian, or other rose from 15% to 36% of the U.S. population (Pew Research Center, 2015). This is relevant in that it draws attention to the significance of the health of minorities. If the health of minorities is compromised, the overall health of a significant proportion of Americans will be compromised when these groups become larger portions of the total population.

NSLP

The NSLP is a federal program that operates in public and not-for-profit private schools (USDA, 2013). The program began in 1946 with the passage of the National School Lunch Act and requires schools to provide children with low cost or free, nutritionally balanced meals. The necessity of such a program was realized when Congress recognized the relationship between the poor health and nutrition status of men rejected by the military during World War I (Martin, 1999). The consciousness of a national malnutrition problem, accompanied by an agricultural surplus, sparked the creation of what is now the NSLP.

By the end of its first year in 1947, the NSLP was serving 7.1 million students (USDA, 2013). In 2012, the NSLP provided lunch to over 31 million students each day. Children from families of low incomes at or below 130 percent of the poverty level are eligible for free lunch. The lunch must adhere to specific meal patterns that provide dairy, protein foods, fruits, vegetables, and whole grains. Specific calorie limits ensure age-appropriate meals for those elementary, middle school, and high school students. Additionally, modifications are constantly reviewed and one recent adjustment was the reduction of sodium content from an average range of 1,377 mg-1,588 mg to 640 mg – 740 mg depending on the student's grade level (USDA, 2012).

The School Breakfast Program

The School Breakfast Program (SBP) is a federally assisted meal program implemented in public and nonprofit private schools as well as residential child care institutions (USDA, 2013). Piloted in 1966, the program was officially launched in 1975. The Healthy, Hunger-Free Kids Act of 2010 recently required the SBP to offer more whole grains, fruits, and reduce sodium content (USDA Food and Nutrition Services, 2012). The Act also required grade level modifications to supply sufficient calories.

Afterschool Snack Program

The Afterschool Snack Program (ASP) gives children another opportunity for nutrition away from the home. The federally assisted program allows for those public, nonprofit, and residential child care institutions with afterschool care programs the option of providing children a snack in exchange for cash subsidies (United States Department of Agriculture [USDA], 2013). In order to qualify, educational or enrichment activities need to be regularly scheduled. Any children of low income families are eligible to receive a free ASP snack. Currently, the program is offered in approximately 25,978 schools and institutions throughout the United States.

Contributions of School Meals to Overall Nutrition

In 2006, school meals provided only 8% of total energy for the year of all American children (Poti & Popkin, 2011). When observing children's dietary

habits of foods consumed outside of the home, school meals were the largest contributor of energy in 1994, but the trend shifted to store bought foods as the main contributor in 2006.

One study concluded that all children regardless of income who participated in the NSLP program consumed 15% to 30% of their total daily intake of fruits and vegetables from the lunch (Robinson-O'Brien et al., 2010). Research from low income schools where 90% of children qualify for free or reduced lunch speaks to the importance of NSLP for low SES children because the lunch contributes largely to their fruit and vegetable intake. The average reported mean daily fruit and vegetable intake among fourth, fifth, and sixth grade children was 3.6 servings per day (Robinson-O'Brien et al., 2010). Over half of the children's daily intake of fruits and vegetables was consumed at school (Robinson-O'Brien et al., 2010). Only 20% of the children were eating the recommended 5 servings of fruits and vegetables each day (Robinson-O'Brien et al., 2010). Those children with the lowest daily fruit and vegetable consumption had the highest proportion coming from school meals which demonstrates the importance of the NSLP program. Thus, school meals serve as a major source of nutritious food for children who may not have access to fruits and vegetables at home (Robinson-O'Brien et al., 2010).

Similar international findings have represented the benefits of school lunch programs. Nutrition data from Newcastle University in England supported the

claim that those children who participated in the school lunch program had an overall lower energy intake from saturated fat and lower sodium intake as compared to those children who brought lunches from home (Spence et al., 2014). However, children who brought their lunch from home showed a higher mean micronutrient intake. Decreased participation in school lunch from 2000 and 2010 is a trend in England that resembles the pattern in the U.S. (USDA, 2015).

Nutrition Standards in the National School Lunch and School Breakfast Programs

A comprehensive overview of SBP and NSLP requirements was provided in the 2010 Healthy, Hunger-Free Kids Act. In a USDA summary, the requirements for the school food programs were modified to meet the 2010 Dietary Guidelines (USDA, 2012). Briefly, the programs are required to comply with the following:

- Offer fruit daily at breakfast and lunch
- Offer vegetables daily at lunch; children *must* select a fruit or vegetable for the meal to be reimbursable
- Offer whole grains; all grains must be whole-grain rich
- Offer a daily meat/meat alternate
- Offer fat-free or low-fat fluid milk
- Reduce sodium content over the span of 10 years

- Food must contain zero grams of trans fat per serving

Children and youth between the ages of 5 and 18 years old may consume up to half of their daily nutrition needs at school (Briefel, Wilson & Gleason, 2009). On average, youth ages 5 to 18 years in the U.S. attend school about 180 days each year for six or more hours each day. Schools and educational facilities are the only institutions that have this type of extensive contact with children during the earlier years of life (Peterson & Fox, 2007). This contact provides the opportunity of educational facilities to positively or negatively impact a child's nutritional status. Therefore, the objective of this study was to assess the contribution of school meals to the total daily dietary intake of low income children, comparing what a child received during all school meals (breakfast, lunch, snacks) to his or her total dietary intake of the day which includes meals and snacks eaten at home.

CHAPTER III

METHODOLOGY

The purpose of this study was to examine the impact of a nutrition intervention with 9-12 year old children at four Houston area Boys and Girls Clubs (BGC). The data was derived from a previous parent study, “Kids Café: Impact of a national feeding program on children’s dietary behaviors.” Results of the parent study have not been published. Parents provided written consent for their children to take part, and children provided assent. Food recalls were collected by trained data collectors. These recalls served as baseline data collected in the fall of 2010. This study was approved by the IRB at Baylor College of Medicine and Texas Woman’s University.

Participants

Students ages 9 to 12 years old participating in the after school program at four Houston area Boys and Girls Clubs were asked to complete two 24 hour diet recalls that were filled out at the club with assistance from a trained interviewer. The data had no identifiers except for gender, race, and age.

Procedure

The diet recall data and demographic characteristics (age, gender, and ethnicity) from the parent study, “Kids Café: Impact of a national feeding program

on children's dietary behaviors" were used for the study. The 24 hour recalls were analyzed by a trained statistician using the Nutrition Data System for Research (NDSR) files (version 2011, Nutrition Coordinating Center, University of Minnesota) to obtain nutrient and food group intake for meals, snacks, and the daily total of the following: fruit, 100% fruit juice; vegetables; grains (e.g., breads, pasta); protein foods (e.g., meat, poultry, fish, cheese); snack chips; sugar sweetened beverages, desserts, and milk. The percentage of energy and food groups obtained from school meals were calculated. Analyses of covariance were conducted to analyze the research questions. The analysis used SPSS 22(IBM Statistics, NY). The significance level was set at $P<0.05$. The null hypotheses were as follows:

The null hypotheses for this study were as follows:

- H1. The mean amounts and percent contribution of energy and food groups consumed at school did not differ by gender.
    - H1a. The mean amounts of energy consumed at school did not differ by gender.
    - H1b. The mean amounts of food groups consumed at school did no differ by gender.
    - H1c. The percent contribution of energy from school meals to daily intake did not differ by gender.

    - H1d. The percent contribution of food groups from school meals to daily intake did not differ by gender.
- H2. The mean amounts and percent contribution of energy and food groups consumed at school did not differ by age.
    - H2a. The mean amounts of energy consumed at school did not differ by age.
    - H2b. The mean amounts of food groups consumed at school did not differ by age.
    - H2c. The percent contribution of energy from school meals to daily intake did not differ by age.
    - H2d. The percent contribution of food groups from school meals to daily intake did not differ by age.
- H3. The mean amounts and percent contribution of energy and food groups consumed at school did not differ by ethnicity.
    - H3a. The mean amounts of energy consumed at school did not differ by ethnicity.
    - H3b. The mean amounts of food groups consumed at school did not differ by ethnicity.
    - H3c. The percent contribution of energy from school meals to daily intake did not differ by ethnicity.

- H3d. The percent contribution of food groups from school meals to daily intake did not differ by ethnicity.

CHAPTER IV
RESULTS

Records of student food selection and consumption were obtained from an initial 109 low income elementary and intermediate school students, between the ages of 9 and 12 years old. However, data was missing from 7 participants so the final sample size was 102 children. As seen in Table 1, the majority of respondents were female and there was a larger group of 9 year olds than any other age group comprising 36.7% of all participants. African Americans accounted for 6.4% of respondents while 33% of participants were Hispanics or Latinos with 21% of children not reporting ethnicity.

Table 1

Demographic Characteristics of Participants[1] by Gender, Age, and Ethnicity

	n	%
Child Gender		
Male	47	43.1
Female	55	50.5
Missing	7	6.4
Age		
9	40	36.7
10	31	28.4
11	26	23.9

(continued)

12	12	11.0
Child Ethnicity		
American Indian or Alaska Native	10	9.2
African American or Black	7	6.4
White	33	30.3
Hispanic or Latino	36	33.0
Missing	23	21.1

Note: [1] n = 102

Table 2 presents the mean servings from food groups provided by school meals by age. There were significant differences by age for the amount of fruit consumed ($p < 0.05$) and total milk ($p<0.05$) consumed from school meals. The 9-10 year old group of participants consumed 0.54 cups of fruit per day while the 11-12 year old participants consumed less with 0.33 cups per day. The younger participants also consumed more milk per day than the older ones. The 9-10 year olds drank 10.97 ounces of milk per day and the 11-12 year old participants drank 7.49 ounces per day. Grain intake was expressed as ounce equivalents by taking the measurement of grains in the product weighed in grams and converting it to ounces. Therefore, the null H2b was rejected that the mean amounts of food groups consumed at school did not differ by age. The null H2a was not rejected that the proportion of energy consumed did not differ by age.

Table 2

Mean Amounts of Energy, Fat, Sodium and Select Food Groups Consumed from School Breakfast and Lunch by Age[1, 2]

	Age			
	9-10 years old		11-12 years old	
Total	Means	SE	Means	SE
Energy (kilocalorie)	849	42	770	66
Fat (gm)	27	2	27	3
Saturated fat (gm)	10	1	10	1
Sodium (mg)	1297	73	1224	113
Fruit + juice(cups)	0.72	0.07	0.53	0.11
Fruit (cups)*	0.54*	0.05	0.33*	0.09
Juice (cups)	0.19	0.04	0.20	0.06
Vegetable (cups)	0.24	0.03	0.20	0.05
Grain (oz eq.)	3.07	0.19	2.65	0.30
Whole grain (oz eq.)	0.81	0.11	0.58	0.17
Other grain (oz eq.)	2.25	0.20	2.07	0.31
Milk (oz)*	10.97*	0.75	7.49*	1.16
Sweetened beverages (cups)	0.20	0.16	0.61	0.24
Snack chips (serving)	0.20	0.05	0.13	0.07
Dessert (serving)	0.12	0.06	0.23	0.09
Protein foods (oz eq.)	2.60	0.22	2.82	0.35

[1.] Adjusted for gender and ethnicity.

[2.] Abbreviation: SE, standard error; gm, grams; mg, milligrams; oz eq., ounce equivalents; oz, ounces.

*Significant finding indicating $P < 0.05$

Mean servings provided by school meals by ethnicity are in Table 3. There were significant differences by ethnicity, therefore H3b that the mean amount of food groups at school did not differ by ethnicity was rejected. American Indian/Alaskan Native children reported consuming more servings of other vegetables than African-American children ($p<0.05$) and White children ($p<0.05$).White children reported consuming more snack chips than Hispanic children ($p<0.05$). There were no significant differences in energy consumed from school meals and therefore H3a was not rejected that the contribution of energy did not differ.

Table 3

Mean Amounts of Energy, Fat, Sodium and Select Food Groups Consumed from School Breakfast and Lunch by Ethnicity[1, 2]

	Ethnicity							
	African American or Black		American Indian or Alaska Native		Hispanic or Latino		White	
Total	Means	SE	Means	SE	Means	SE	Means	SE
Energy (kilocalorie)	742	128	787	101	825	60	847	57
Fat (grams)	23	5	25	4	27	2	30	2
Saturated fat (grams)	9	2	10	2	10	1	11	1

(continued)

Sodium (mg)	1182	218	1164	173	1262	101	1381	96
Fruit + juice (cups)	0.68	0.22	0.62	0.175	0.715	0.10	0.57	0.10
Fruit (cups)	0.36	0.17	0.54	0.13	0.49	0.08	0.36	0.07
Juice (cups)	0.32	0.12	0.09	0.10	0.23	0.06	0.21	0.05
Vegetable (cups)	0.14	0.11	0.25	0.08	0.28	0.05	0.19	0.05
Grain (oz eq.)	3.02	0.58	2.31	0.46	2.93	0.27	3.07	0.26
Whole grain (oz eq.)	0.94	0.33	0.66	0.26	0.47	0.15	0.78	0.15
Other grain (oz eq.)	2.08	0.59	1.65	0.47	2.46	0.28	2.28	0.26
Milk (oz)	8.25	2.27	9.95	1.80	10.19	1.06	8.09	1.01
Total sweetened beverages (cups)	0.08	0.47	0.65	0.37	0.20	0.22	0.41	0.21
Dessert (serving)	0.04	0.18	0.30	0.14	0.14	0.08	0.15	0.08
Snack chips (serving)*	0	0.15	0.18	0.12	0.08*	0.07	0.36*	0.07
Protein foods (oz eq.)	2.88	0.69	2.36	0.55	2.81	0.32	2.89	0.31

[1.] Adjusted for age and gender. (continued)

[2.] Abbreviation: SE, standard error; mg, milligrams; oz eq., ounce equivalents.

*Significant finding indicating $P < 0.05$

There were significant differences in the consumption of total protein foods by gender ($p<0.003$) (Table 4). Thus, H1b that the mean contribution of food groups at school did not differ by gender was rejected. Males consumed 3.13 oz eq. of protein foods per day from both school breakfast and lunch while females consumed 2.34 oz eq. per day from school meals (Table 4). There were no significant differences in energy consumption from school meals, therefore H1a that the proportion of energy consumed at school did not differ by gender was not rejected.

Table 4

Mean Amounts of Energy, Fat, Sodium and Select Food Groups Consumed from School Breakfast and Lunch by Gender[1, 2]

	Gender			
	Male		Female	
Total	Means	SE	Means	SE
Energy (kilocalorie)	811	63	790	59
Fat (grams)	28	2	25	2
Saturated fat (grams)	10	1	9	1
Sodium (mg)	1257	107	1238	100
Fruit + juice (cups)	0.63	0.11	0.66	0.1
Fruit (cups)	0.43	0.08	0.44	0.08
Juice (cups)	0.20	0.06	0.23	(continued)
Vegetable (cups)	0.2	0.05	0.23	0.05

Grain (oz eq.)	2.64	0.28	3.02	0.27
Whole grain (oz eq.)	0.69	0.16	0.74	0.15
Other grain (oz eq.)	1.95	0.29	2.29	0.27
Milk (oz)	9.29	1.12	8.95	1.05
Sweetened beverages (cups)	0.50	0.23	0.17	0.22
Dessert (serving)	0.15	0.09	0.17	0.08
Snack chips (serving)	0.08	0.07	0.21	0.07
Protein foods (oz eq.)*	3.13*	0.34	2.34*	0.32

[1.] Adjusted for age and ethnicity
[2.] Abbreviation: SE, standard error; gm, grams; mg, milligrams; oz eq., ounce equivalents; oz, ounces
*Significant finding indicating P < 0.003

There were no significant differences by age of the percent contribution of school meals to the total day's dietary intake in energy or food groups (Table 5); therefore, we do not reject H2c or H2d that there were no differences in the percent contribution of energy or food groups by age. From 53% to 52% of the days' energy intake was provided by school meals for these children when compared by age. School meals constituted for 42% to 37% of the daily vegetable intake for children and 77% to 66% of their daily fruit intake. School meals made up 81% to 87% of the participants' daily milk intake and constituted for 53% to 54% of their total protein intake. School meals constituted 5% to 10% of the participants' daily sweetened beverage intake which is relatively low and may be because only milk is served during breakfast and lunch.

Table 5

Percentages of Daily Energy, Fat, Protein, Sodium, and Food Groups Contributed From School Breakfast and Lunch to Overall Daily Intake by Age[1, 2]

	Age			
	9-10 years old		11-12 years old	
Percent	Means	SE	Means	SE
Energy	53	2	52	4
Fat	50	3	49	4
Saturated fat	49	2	47	4
Sodium	49	2	48	4
fruit + juice	64	5	63	9
Fruit	77	6	66	11
Juice	59	10	64	16
Vegetable	42	4	37	7
Grain	51	3	52	5
Whole grain	66	7	69	11
Other grain	46	4	48	6
Milk	81	6	87	9
Sweetened beverages	5	3	10	5
Snack chips	35	11	49	13
Dessert	36	9	38	15
Protein foods	53	3	54	

(continued)

[1.] Adjusted for gender and ethnicity

[2.] SE = standard error.

There were no significant differences in the percent contribution of school meals to daily intake in energy or food groups by ethnicity, controlling for gender and age displayed in Table 6. Therefore, we do not reject H3c or H3d that states there is no difference in the contribution of school meals to energy or food groups by ethnicity. School meals accounted for 42% to 56% of participants' total daily energy intake and 57% to 72% of their total fruit plus fruit juice intake, with the highest contribution for Hispanics or Latinos and the lowest contribution in whites. School meals accounted for 16% to 47% of participants' total daily vegetable intake. The highest contribution for vegetable intake was among American Indian and Alaska Natives.

Table 6

Percentages of Daily Energy, Fat, Protein, Sodium, and Food Groups Contributed From School Breakfast and Lunch to Overall Daily Intake by Age[1, 2]

	Ethnicity							
	African American or Black		American Indian or Alaska Native		Hispanic or Latino		White	
Percent	Means	SE	Means	SE	Means	SE	Means	SE
Energy	42	7	54	6	56	3	51	3
Fat	38	8	45	6	53	4	(continued)	3
Saturated fat	38	8	48	6	54	4	51	3

Sodium	40	7	45	6	53	3	50	3
Fruit+ juice	58	16	66	13	72	7	57	8
Fruit	74	19	68	15	86	9	59	9
Juice	61	28	59	29	58	14	65	15
Vegetable	16	13	47	11	45	6	38	6
Grain	40	9	40	8	60	4	52	4
Whole grain	89	24	65	17	68	10	59	9
Other grain	29	11	35	9	56	5	50	5
Milk	70	16	99	13	80	8	88	7
Sweetened beverage	2	9	28	10	3	4	4	4
Dessert	4	25	82	24	32	12	27	11
Snack chips	3	54	31	24	37	14	57	11
Protein foods	54	10	56	8	54	5	54	4

[1.] Adjusted for age and gender.
[2.] SE = standard error.

There were no significant differences in the percent contribution of school meals to daily intake of energy and food groups by gender (Table 7). Thus, we do not reject H1c or H1d stating there were no differences in percent contribution of energy or food groups from school meals by gender. School meals contributed more to the daily energy intake of males (52%) than females (50%). Total daily intake of fruit plus fruit juice percentage for males (65%) was

Table 7

Percentages of Daily Energy, Fat, Protein, Sodium, and Food Groups Contributed From School Breakfast and Lunch to Overall Daily Intake by Gender[1, 2]

	Gender			
	Male		Female	
Percent	Mean	SE	Mean	SE
Energy	52	4	50	3
Fat	48	4	44	3
Saturated fat	50	4	45	4
Sodium	49	4	45	(continued)
Total fruit+ juice	65	8	62	8
Fruit	73	10	70	9

Juice	52	16	69	14
Vegetable	43	6	31	6
Grain	48	5	48	4
Whole grain	74	10	67	11
Other grain	41	5	44	5
Milk	84	8	85	8
Sweetened beverage	8	4	10	5
Dessert	29	13	43	12
Snack chips	35	20	29	17
Protein foods	57	5	52	5

[1.] Adjusted for age and ethnicity.
[2.] SE = standard error.

Table 8

Hypotheses and determination of accept or reject based on results.

Hypothesis	Accept or Reject
H1a	Accept
H1b	Reject
H1c	Accept
H1d	Accept
H2a	Accept
H2b	Reject
H2c	Accept

(continued)

H2d	Accept
H3a	Accept
H3b	Reject
H3c	Accept
H3d	Accept

CHAPTER V

DISCUSSION

The contribution of school meals to the daily intake of low income children in the BGC study was examined to assess for any differences by age, gender, and ethnicity. The proportion of some food groups differed by gender, age, and ethnicity. However, the proportion of energy did not differ. Therefore, the H1a, H2a, and H3a were accepted. There were significant differences by ethnicity. American Indian/Alaskan Native children reported consuming more servings of vegetables than African-American children ($p<0.05$) and White children ($p<0.05$).White children reported consuming more snack chips than Hispanic children ($p<0.05$). Therefore H3b was rejected because the proportion of food groups differed by ethnicity. There were also significant differences in the consumption of total protein by gender, controlling for age and ethnicity ($p<0.003$). Thus, H1b was rejected. Males consumed 3.13 grams of protein from both school breakfast and lunch while females consume 2.34 grams from school meals.

Age

This BGC study found that school meals accounted for 53% of 9 and 10 year-old participants total energy. In contrast the USDA's School Nutrition Dietary Assessment Study III (SNDAIII) indicated that school lunch accounted for 30% of elementary aged NSLP participants' daily energy intake (USDA, 2013). SNDAIII found that school lunch made up 32% of the intermediate school children's daily energy intake. The BGC study indicated that school meals made up 52% of the total daily energy intake of 11 and 12 year-old participants. SNDA III found that school breakfast contributed an average of 21% to elementary and intermediate students' daily energy intake (USDA, 2013). When combining the average percentages of school lunch and breakfast contribution to overall daily energy intake published from SNDA III, the percentages are closer to the results of the BGC study.

The SNDA III study was conducted for the 2004-2005 school year during the second half of the year, much earlier than the Houston BGC study. SNDA III was conducted by the Food and Nutrition Service Department of the USDA and studied all school meal participants and non-participants; all students regardless of income. SNDA III differs from the BCG study in that data was obtained from all students and the BCG study only reported on food records from low-income children. This

difference could provide an explanation on the variations between SNDAIII and BGC regarding participation in lunch and breakfast. The inclusion of all students regardless of income may mean more students bring a lunch from home because a higher income may make it more feasible to bring a lunch than it is for those of low income families.

When combining the data from breakfast and lunch of SNDAIII, the data is comparable to the BGC study. However it is difficult to compare the data from these two studies because it is not certain that the same number of students who eat breakfast also eat lunch and vice versa. The higher contribution of school meals to overall intake found in the BGC study when compared to the SNDAIII study could be because the BGC study combined data from breakfast and lunch and did not separate the two meals. Perhaps if the data from the BGC study had been further analyzed by meal, the data would have been more similar to SNDAIII.

SNDA III did not provide data on all food groups, but rather macronutrients, vitamins, and minerals, which makes the BGC study unique. SNDA III reported that school meals contributed 32% saturated fat from lunch and 17% from breakfast for elementary students. The total saturated fat contribution found in the BGC study for the elementary-aged participants was 49%. SNDA III reported school meals contributed 34% total daily saturated fat intake from lunch and 18% from breakfast for

intermediate-aged children. The BGC study found the saturated fat contribution from school meals was 47% for intermediate-aged participants (intermediate school is also referred to as middle school and includes grades 6-8). SNDA III reported that school lunch contributed 35% of elementary students' daily protein intake and breakfast contributed 19% of elementary students' daily protein intake. The BGC study found daily protein contribution of 53% for the same age participants for breakfast and lunch combined. Concerning intermediate students, SNDA III reported that school lunch accounted for 35% of students' protein intake and school breakfast contributed 19% of their daily protein intake. The BGC study found that school meals contributed 54% of 11 and 12 year-olds' daily protein intake.

A more recent study conducted with an age group similar to the BGC study compared school lunch and breakfast contributions without the new guidelines in 2011(Cullen, Chen, Dave & Jensen, 2015). The study observed students from eight different schools within one district of Southeast Texas; four low income schools and four middle income schools. Low income and middle income schools were determined based on the percent of students receiving free and reduced price lunches. In the Southeast Texas study, there was an average of 716 students per school and ethnicities were African-American (6%), Hispanic (34%), White (49%),

and other (10%) (Cullen, Chen, Dave & Jensen, 2015). The Southeast Texas study defined low income schools as having 49%-79% students receiving free or reduced price lunch and the middle income schools had 7-18% of students receive free or reduced price lunches. The BGC study was also considered to be low income children based on participation in the afterschool BGC program.

When comparing results, intermediate students of the Southeast Texas study had a lower calorie total than did students of a similar age in the BGC study. While the calorie total of intermediate students was 599 for the Southeast Texas study, the energy total for students aged 11 and 12 was 738 kcals per day and 772 kcals per day respectively for the BGC study (Cullen, Chen, Dave & Jensen, 2015). Elementary school students of the Southeast Texas study also reported lower energy intake (614 kcals per day) than the 9 and 10 year olds of the BGC study which averaged 807 kcals per day for 9 year-olds and 882 kcals per day for 10 year olds (Cullen, Chen, Dave & Jensen, 2015). Whereas the BGC study specifically observed low income children, the Southeast Texas study observed low income schools, meaning there was still a mixture of income levels within the group of participants. This could provide an explanation of the higher energy totals in the BGC study, as families of low SES tend to choose more energy dense foods (Kant & Graubard, 2013).

Fruit intake from school meals for the BGC study was similar to the Southeast Texas study which reported an average intake of 0.12 cups per day of fruit selected for intermediate participants and 0.26 cups per day for elementary-aged participants. In comparison, children ages 11 and 12 in the BGC study consumed 0.33 cups per day and children ages 9 and 10 consumed 0.54 cups per day. Total vegetable contribution from school meals for the BGC study was 0.20 cups per day for the intermediate age group and 0.24 cups per day for elementary students compared to an average 0.14 cups per day for intermediate and 0.22 cups per day for elementary participants reported in the Southeast Texas study. School meal contributions were higher for the BGC study in all other food groups such as milk, total grain, and protein foods for intermediate ages and elementary ages than were in the Southeast Texas study (Cullen, Chen, Dave & Jensen, 2015).

Gender

Research is limited concerning school meal contribution and differences in gender. The BGC study found a significant difference in the amount of protein consumed by males and females from school meals. Therefore the null H1b was rejected that the proportion of food groups did not differ by gender. Males 9-13 years old commonly require 200 to 400 more calories a day in contrast to females of the same age (USDA, 2010).

This disparity of energy needs could contribute to the significant increase in protein consumption at school meals among males. However, males did not have a higher school meal contribution for all food group and macronutrient categories. Previous research noting a gender difference in protein intake with school meals has not been reported.

Ethnicity

A low income, ethnically diverse study with students from Minnesota concluded that those children who participated in the NSLP program consumed over half of their total daily intake of fruits and vegetables from school meals (Robinson-O'Brien et al., 2010). The Minnesota study was similar to the BGC study and included 103 children; 78 females, and 25 males. The students ranged in age from 9 to 12 years old and attended one of four urban elementary schools which served primarily low-income populations who participated in an afterschool program. The four schools had 90% of students eligible for free or reduced school lunch. The ethnicities studied were African-American, Asian/Hmong, White, Hispanic, and mixed or other.

Participants in the BGC study received from 31% to 73% of their total daily fruit and vegetable intake from school meals depending on gender. School meals also contributed a substantial portion of total daily fruit and vegetable intake in the Minnesota study (64% females, 51%

males) (Robinson-O'Brien et al., 2010). The Minnesota study reported that the daily fruit and vegetable intake and proportion consumed at school did not differ statistically by gender, race, or age, results which are similar to the BGC study.

African-Americans in the BGC study received 16% of their daily vegetable intake from school meals in comparison to the African-Americans (51%) in the Minnesota study. African-Americans received 74% of their total fruit intake from school meals for Minnesota study (Robinson-O'Brien et al., 2010). The BGC study also found that school meals contributed 74% of African-American students' total daily fruit intake. Whites of the Minnesota study received 52% of their total fruit intake from school meals and 33% of their total daily vegetables from school meals. The BGC study reported a school contribution of 59% to white students' total daily fruit intake and 38% total vegetable intake which is similar to the findings of the Minnesota study. All other races reported in the Minnesota study did not report its findings regarding Hispanic participants.

Strengths

Strengths of the study include trained nutrition educated individuals as interviewers for the diet recalls and the specification of low income children. The information from the food recalls was analyzed using NDSR, a reputable

program. Studying low income children created a special niche for the BGC study but is also important because it observed a high risk population. Inclusion of an ethnically diverse population and use of two dietary recalls to estimate food intake were additional strengths.

Limitations

There are limitations regarding diet recalls, particularly with children, as it may be difficult for a child to remember what he or she ate earlier that day, as well as estimate potion size. However, for the purposes of this study, a diet recall was the most suitable way to obtain the information. The sample size for this study was relatively small with 109 participants and the location was confined to Houston area Boys and Girls Clubs. Therefore the results are not generalizable to other locations, children of higher income families or other age groups. Whether the intake of school meals varies by weight status is another important area for further study.

CHAPTER VI

CONCLUSIONS AND IMPLICATIONS FOR FUTURE RESEARCH

The current study documents the important contribution of school meals to low income students. However, a future study should be conducted to determine whether school meals are sufficient to meet the needs of this low income population by comparing contribution to DRI's. Future studies should enroll more students with diverse ages and ethnicities as well as other geographical locations.

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APPENDIX A
Institutional Review Board, Baylor College of Medicine Approval

September 23, 2014

JAYNA MARKAND DAVE
BAYLOR COLLEGE OF MEDICINE
PEDIATRICS: NUTRITION

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H-35369 - KIDS CAFE: IMPACT OF A NATIONAL FEEDING PROGRAM ON CHILDREN'S DIETARY BEHAVIORS(FORMERLY H-26820)

APPROVAL VALID FROM 9/23/2014 TO 8/26/2015

Dear Dr. DAVE

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, operates, and is registered with the United States Office for Human Research Protections according to the regulations codified in the United States Code of Federal Regulations at 45 CFR 46 and 21 CFR 56. The BCM IRB operates under the BCM Federal Wide Assurance No. 00000286, as well as those of hospitals and institutions affiliated with the College.

Sincerely yours,

V. Reid Sutton

VERNON R SUTTON, M.D., B.S.
Institutional Review Board for Baylor College of Medicine and Affiliated Hospitals

APPENDIX B
Institutional Review Board Exempt Approval

TWU
TEXAS WOMAN'S UNIVERSITY
DENTON DALLAS HOUSTON

Institutional Review Board
Office of Research
6700 Fannin, Houston, TX 77030
713-794-2480
mjackson3@twu.edu
http://www.twu.edu/irb.html

DATE: December 3, 2014

TO: Ms. Esther Ellis

FROM: Institutional Review Board - Houston

Re: Exemption for The contribution of school meals to low income children's daily caloric intake (Protocol #: 17970)

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

If applicable, agency approval letters must be submitted to the IRB upon receipt PRIOR to any data collection at that agency. Because a signed consent form is not required for exempt studies, the filing of signatures of participants with the TWU IRB is not necessary.

Although your protocol has been exempted from further IRB review and your protocol file has been closed, any modifications to this study must be submitted for review to the IRB using the Modification Request Form. Additionally, the IRB must be notified immediately of any adverse events or unanticipated problems. All forms are located on the IRB website. If you have any questions, please contact the TWU IRB.

cc.
Graduate School