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Relationship of School Breakfast Environment and Participation to Child Dietary Intake and Body Weight in Five Rural Appalachian Schools

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To the Graduate Council:

I am submitting herewith a thesis written by Andrea Leigh Graves entitled "Relationship of School Breakfast Environment and Participation to Child Dietary Intake and Body Weight in Five Rural Appalachian Schools." I have examined the final electronic copy of 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.

Betsy Haughton, Major Professor

We have read this thesis and recommend its acceptance:

Sonya Jones, Lisa Jahns, Gene Fitzhugh

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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Anne Mayhew
Vice Chancellor and
Dean of Graduate Studies

(Original signatures are on file with official student records)

Relationship of School Breakfast Environment and Participation to Child Dietary Intake and Body Weight in Five Rural Appalachian Schools

A Thesis
Presented for the
Master of Science Degree
The University of Tennessee, Knoxville

Andrea Leigh Graves
December 2005

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Abstract

Objective The purposes of this study were two-fold: 1) to assess the school breakfast environment at four rural Appalachian schools for the contribution of foods to calories, fat, and fiber; and 2) to assess the dietary intake of students in these schools in relation to where breakfast was consumed (home, school, or both places) and by student weight status.

Setting Four rural Appalachian schools with fourth and fifth grade students in East Tennessee.

Subjects 255 fourth grade children completed a 24-hour dietary recall with a trained NDS-R interviewer and were weighed and measured by the Coordinated School Health Program.

Design Assessment of baseline data from an intervention study targeting 4th and 5th grade students in one rural East Tennessee county, Youth Can!, was used. School food service managers submitted school menus and production sheets for 18 days, and vendor bid sheets for analysis of the school breakfast environment. NDS-R software was used to analyze each breakfast food item for calories, fat, and fiber content per serving and production sheets were used to determine amounts of each breakfast food item served. Dietary recalls for days when school breakfast could be consumed were analyzed for energy and target nutrients using NDS-R software. Weight status was calculated as at risk of or overweight and not at risk of overweight based on BMI percentile for age.

Statistics Descriptive statistics were used to describe the school breakfast environment in terms of calories, fat and saturated fat (grams, percent calories) and fiber (grams) from foods sold on a per person basis. Food items also were grouped by the five meal components of the School Breakfast Program and ranked according to the total items served. Relationships between dietary intake and breakfast location and child weight status were evaluated using analysis of variance. Relationships between breakfast location and child weight were examined using chi-square tests.

Results On average in these school environments fat provided slightly less than half the calories (43%); 15% of calories were from saturated fat. The top ranked foods for servings sold for each meal component were biscuits, sausage, 2% milk, orange juice, and gravy. Children consuming breakfast at home and school had significantly higher percent breakfast contribution to the entire day for energy and calcium compared to children who only ate breakfast at home or school. While children who ate breakfast at home had significantly lower percent breakfast contributions to the entire day for percent calories from fat, protein compared to children who ate at school. Children who ate breakfast only at school had lower percent breakfast contribution to the entire day for iron and vitamin A compared to children who ate breakfast only at home. Breakfast consumption regardless of location had no impact on child weight status.

Conclusion The high fat content school breakfast environment reinforces the importance of healthy school food policies and technical support and resources for food service programs to provide low-fat meal options. However, children are not consuming all the breakfast items being served at school. Further research is needed to determine the impact physical activity and socio-economic status have on weight.

Preface

To aid the reader, an explanation of the format used for this thesis follows. This thesis consists of three parts. Part I contains an introduction, extensive review of the literature and the study's research questions. Parts II and III contain the actual study written in journal style format for two publications.

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Part I

Overview

Introduction

One in three children in the United States is either at risk for overweight or is overweight (1). In Tennessee, more than 20% of children are overweight and this does not include those that are at risk for being overweight. In the rural Appalachian county of this study, 46% of the students are either at risk for overweight or overweight (2). Overweight in children has doubled over the past two decades (3) and childhood and adolescence have been shown to be critical periods for the development of overweight (5). Overweight children often remain overweight through adolescence and into adulthood (5-6).

Children who skip breakfast have also been shown to be heavier than those that consume breakfast (4, 7). Therefore, breakfast consumption can have a positive affect on child weight and reduce the odds of being overweight by 30% (4). The National School Lunch Program (NSLP) and School Breakfast Program (SBP) were designed to safeguard the health of the nation's children (8). One in 10 children consume two of their three major meals at school and more than half of students consume one of their three major meals at school (9). However, school meals have been shown to be high in fat, saturated fat, cholesterol, and sodium (9). Studies have shown that the SBP in particular provides 31% of energy from total fat and 14% of energy from saturated fat (10). SBP participants typically have higher intakes of food energy, protein, and calcium than non-participants. SBP participants also tend to derive a greater proportion of energy from fat and saturated than non-participants (11). Given the rise of overweight among children, the positive relationship between breakfast consumption and reduced weight, and the known higher fat content of SBP meals, it stands to question do students who participate in school breakfasts have a different Body Mass Index for age (BMI) than students who eat breakfast at home or somewhere else? This study attempted to answer that question by looking at the school breakfast environment and then the dietary intake and weight status of SBP participants and non-participants.

Review of Literature

Child Weight Status

Fifteen percent of the nation's children are overweight ($\geq 95^{th}$ percentile on BMI-for-age chart) and this does not include the children who are at risk for being overweight ($\geq 85^{th}$ to $<95^{th}$ percentile on BMI-for-age chart) (1, 3, 12). More than 20% of children in Tennessee are overweight by self-report, which exceeds this national average (2). Mokdad et al (13) reported in the *Journal of the American Medical Association* that poor diet and physical inactivity was the second leading cause of death (16.6%) in 2000 and had the largest increase of all actual causes of death. "Overweight would account for the major impact of poor diet and physical inactivity on mortality" (13 p. 1240). Deaths due to poor diet and physical inactivity could increase even more when the full effect of current rates of overweight and obesity is manifested in increased chronic disease rates in the future (13). Others have shown that large numbers of overweight children remain overweight in the adolescent years and even into adulthood, thus making childhood and adolescence two critical periods for the development of overweight (5).

The school environment may have a role in the overall health of children. The School Nutrition Dietary Assessment Study (14) found that 24.6 million (58%) children eat lunch at school and nearly 5 million (20%) eat breakfast at school. This means that nearly 1 in 10 children are consuming 2 of their 3 major meals and more than half are consuming 1 of their 3 major meals at school with the remaining meals consumed at home or somewhere besides school (9). Between 35% to 40% of students' total daily energy is consumed at school. Thus, the school food environment has the possibility of having a significant impact on children's diet and weight (15) and subsequent health status. With this important contribution to nutrient intake, it is important to assess the effect foods offered at school have on the nutritional and weight status of children.

School Food Environment

The National School Lunch Program (NSLP) and the School Breakfast Program (SBP) were designed to protect children's health and to encourage consumption of nutritious foods. The NSLP and SBP are federally sponsored and available to all public and private nonprofit elementary and secondary schools. Since the 1940s, the programs have been under surveillance to ensure that the programs are providing the balanced nutrition they were established to provide (16).

Both the NSLP and SBP have meal pattern components that are required for the meal to qualify for federal reimbursement. NSLP meal components include one daily serving of meat or meat alternative (such as eggs, cheese, dried beans, etc.), one daily serving of a bread or bread alternative (such as pasta, rice and other cereals), two or more daily servings of vegetables and fruits (provided from two menu items), and one daily serving of fluid milk (10). Children in many schools only have to choose 3 of the 5 components to have a reimbursable NSLP lunch. Using this approach, the NSLP endeavors to meet approximately one-third of the RDA for specific nutrients (16).

The SBP has similar components that include either one serving of meat or meat alternative and one serving of bread or bread alternative, or two servings of either group. In addition to the meat/bread combination, one serving of fruit, vegetable, or full strength juice and one serving of fluid milk must also be offered (10). The SBP attempts to meet one-fourth of the RDA for specific nutrients (16). In addition, schools offer *a la carte* items that do not have to meet the NSLP or SBP guidelines. The *a la carte* items typically provide additional funding to operate the cafeteria.

Several studies have attempted to describe the school food environment, particularly in relationship to school lunch. Kubik and colleagues (17) described the school lunch environment in relation to the National School Lunch Program (NSLP) requirements, *a la carte* options, snack and beverage vending and school stores using school-level production records at 16 schools in the St. Paul – Minneapolis area. Three school-level variables were created: mean number of daily servings of fruits, vegetables, and fried potatoes sold for every 100-school lunches. *A la carte* programs were evaluated by trained specialists who observed and recorded the number of items offered and sold to students. Foods then were grouped according to “foods to limit” or “foods to promote.” Foods classified as “foods to promote” included snacks containing less than 5g of fat per serving, 100% fruit juice, bottled water, and 1% and skim milk. Lower fat versions of high-fat foods, such as baked French fries and school prepared desserts with less than 7g per serving, also were included in “foods to promote.” All other snacks were considered “foods to limit.” Trained specialists met with school representatives to analyze the availability of foods from school stores and vending machines that were accessible to students. Results revealed that schools with *a la carte* programs had students who were exceeding the USDA daily recommendations for fat, while those students without access to a la carte programs were not. The study also found a statistically significant negative association with school snack vending machines and student intakes of total daily average servings of fruits (17).

Another study took a similar approach by documenting all foods available at school during lunch (15). Although focused on the school lunch food environment this study provides another model for how to assess the school food environment. French et al (15) focused on foods available as *a la carte* and through vending machines. The study was conducted with 20 secondary schools, all of which were participating in the NSLP. *A la carte* foods were defined as all foods available for sale during lunch that were not sold as part of the reimbursable school meal (second servings). Beverages and food bar items that could not be separately monitored for sales or nutritional information (pasta, potato, salad bars) also were not included in the classification of *a la carte* foods. Research staff completed *a la carte* food inventories following school food service menu data collection protocols used by the Nutrition Coordinating Center of the University of Minnesota. *A la carte* foods were grouped according to either foods with similar fat or other nutrients-of-interest content or foods that had a large share of *a la carte* sales.

Information on vending machines was collected via site visits to all schools. Vending machines were only counted if students had access to the machines. The machines were classified by types of products sold: snack (nonrefigerated and candy bars, chips, gum, etc), soft drink (primarily soft drinks but some fruit drinks or water), and other (half of the machines columns filled with drinks other than soft drinks). Researchers also verified the amount of time that vending machines were available to students for each type of machine.

All information collected was entered into the Nutrition Data System for Research (NDS-R) system to calculate nutrient content and descriptive statistics were used for energy, macronutrients, and micronutrients of interest: kilocalories, total and saturated fat, percentage of fat energy, and selected vitamins and minerals (15).

French et al (15) found that combined items from the chips/crackers and ice cream/frozen desserts categories were available in all but one school and accounted for 21.5% of *a la carte* foods. Fruit and vegetable items accounted for only 4.5% of total *a la carte* foods in 17 of the schools. More than two thirds of the schools studied had soft drink machine contracts. French et al (15) expressed concern for their findings because other studies (9, 18-21) had shown that adolescents were consuming 35% to 40% of their total energy intake at school and a large portion of this could be attributed to the *a la carte* foods and vending machines (15).

Wildey et al (22) depicted the food environment as *a la carte* items, school stores and vending machines in middle schools (grades 6-8). They specifically studied the fat and sugar content of foods purchased by students at school stores. Researchers investigated 24 middle schools (grades 6 through 9), 14 of which had school stores. Schools with stores then were assigned a 1-week (five day) assessment period. Store managers were asked to submit sales as items sold and the nutrition facts (servings per container, total fat [g], and sugars [g]) for each unique food sold in the store. Wildey et al (22) assumed that each student who purchased an item consumed the entire item. Statistical analysis of foods sold was completed using the Statistical Package for the Social Sciences (SPSS). The researchers found that in just one-week nearly 10,000 snack food items had been bought by students at 13 schools and the average snack consumed provided 8.7 g fat and 23.0g sugar per serving.

Menu Documentation

Two main research groups have documented successful methods for assessing the school food environment using menu documentation: Child and Adolescent Trial for Cardiovascular Health (CATCH) (23) and a study of school food service environments by Zive et al (24). Both studies collected five consecutive days of school food service menus. Researchers then interviewed the food service employees for recipes of items on the school menu. Each school was asked to save labels from all food products served to students. For analysis purposes, if items were offered as self-serve items, then a standard serving size was assigned to the item.

Researchers then used school meal participation forms to assess the number of breakfasts and lunches served. Production sheets were used to determine the number of servings of each food item prepared and then how much was sold or left over. In addition, the production sheets were used to determine how many adults had been served, so that amounts could be adjusted to exclude adult meals.

Nutritionists on the CATCH (23) and Zive et al (24) projects compared information gathered from the food service employees to kitchen production sheets, school menus, and food labels to identify any foods that were missing. Cafeteria managers then were interviewed to provide more detailed information about the foods served. In follow-up interviews, school cooks were interviewed to complete recipe forms for any item prepared with two or more ingredients. If any food had missing information (i.e. serving size, nutrient content), the vendor for the food was contacted for label information. All information collected by the research teams then was entered into a nutrient analysis program (both studies used NDS-R) (23-24). Using this method the school food service environment was described as various combinations of energy, macronutrients, and micronutrients expressed on a per child basis.

Defining NSLP and SBP Participation

Typically, researchers have expressed student participation in NSLP as foods reported being obtained and consumed at school (25). During the 1990s, the USDA completed a study of the dietary intake of children and the relationship school meal participation has on intake. Dietary intake was collected during 1994-1996 by the Continuing Survey of

Food Intake by Individuals (CSFII). Parents were allowed to assist children aged 6-11 and older children reported intake independently. During the survey, children reported which foods had been purchased and consumed at school. This study found that students participating in the NSLP had higher intakes of food energy, total fat, saturated fat and sodium, but lower intakes of added sugars (25).

Gleason and Suitor (26) used the CSFII and determined NSLP participation based on a child consuming 3 of the 5 USDA school lunch components. Although all children in a school can participate by purchasing a full price meal, some children receive a free or reduced cost meal. Only the reimbursable meal needs to meet the dietary guidance. Schools typically classify NSLP participation based on foods selected rather than on foods consumed. However, when Gleason and Suitor compared school participation rates, based on foods selected, to the study participation rates, based on foods consumed, there was a discrepancy. To compensate for this difference Gleason and Suitor (26) revised their protocol to base participation on a child consuming any USDA meal component at lunch. They then found that students participating in the NSLP consumed roughly 30% of the recommended energy allowance compared to 26% by nonparticipants. In addition, the NSLP provided an increase in dietary fat and a decrease in added sugars (26).

Breakfast intake in children has been defined as all foods a child consumes from the time he or she wakes up until 45 minutes after school starts (8). School Breakfast Program (SBP) participation has been defined as those foods consumed at a school participating in the SBP (27). Friedman and Hurd-Crixell (27) observed school breakfast programs for eight days and then selected students who consumed breakfast at school for most of those days for further analysis. Students had the option of selecting an entrée or dry cereal and buttered toast, both served with juice and milk. Researchers used a visual plate-waste method to determine the intake of the students and found that student food consumption met USDA SBP requirements for protein, calcium, and Vitamin C. However, the menus did not meet requirements for Vitamin A, iron, and energy and exceeded requirements for total fat and saturated fat (27).

Gleason (8) used another approach to define SBP participation. He used a 24-hour dietary intake survey of 3,350 students in grades 1to 12 in combination with data on school characteristics and programmatic characteristics of the cafeteria meal service provided by school personnel. SBP participants were defined as those students who reported obtaining at least two of the SBP meal-pattern requirements (8). Gleason (8) found that roughly 19% of students who attended a school that offered the SBP actually consumed school breakfast.

From this review, it is evident that there are multiple methods of determining NSLP and SBP participation. However, most researchers analyzed what students consumed at school and a combination of USDA meal components or classification based on school participation in the NSLP and SBP. Therefore, it is important to understand what students report consuming, what the cafeteria reports serving, and if the school is participating in NSLP and SBP.

How to Measure Child Dietary Intake

Various studies have used multiple methods to examine the impact the NSLP and SBP have on specific nutrient intakes. Nutrients included in these examinations of children's diets have been energy (kcal), protein (g), carbohydrate (g), fiber (g), fat (g), saturated fat (g), energy contribution (%) from protein, carbohydrate, fat, and saturated fat, and calcium (mg), iron (mg), vitamin A (RE), vitamin C (mg), sodium (mg) (27-29), cholesterol (mg) (26), and added sugars (g) (28).

Several methods are available to measure a child's diet intake. A widely used method for collecting dietary intake is the 24-hour recall method (26, 30). Gleason and Suitor (26) used dietary recall data from the Continuing Survey of Food Intake by Individuals (CSFII) (1994-1996). They used two-day dietary recalls from children aged 6-18 years who attended schools that offered a lunch program during the CSFII. They found that children participating in the NSLP had an increased intake of dietary fat as a percentage of energy and a decreased intake of added sugars. In addition, the NSLP also had a significant positive impact on vitamin, mineral, and fiber intake even over 24 hours for Vitamin B12, riboflavin, calcium, magnesium, phosphorus, and zinc (26).

Gordon and McKinney (30) also reported dietary intakes using a 24-hour dietary recall for school-aged children. A nationally representative sample of 3,350 1-12 grade students completed dietary intake interviews. During the interview students first listed all foods and beverages they consumed during the 24-hour period prior to the interview. Students then were asked to describe each food with as much detail as possible, while the interviewers recorded the detailed food descriptions, including brand names and recipes where appropriate. Nutritionists at the University of Minnesota analyzed the food recalls and each student's intake of food energy, protein, vitamins, and minerals. Protein, vitamin, and mineral consumption were converted to percentage of the Recommended Dietary Allowance (RDA). Gross intakes were reported for foods without an RDA: energy was measured in kilocalories, fat and carbohydrates were measured in grams and sodium and cholesterol were measured in milligrams (30). Gordon and McKinney (30) found that students participating in the NSLP had higher intakes of protein, Vitamin A, calcium, magnesium, zinc (all expressed as % of RDA), and also had higher intakes of fat, sodium, and cholesterol all (expressed as amount) compared to nonparticipants. However, NSLP participants and nonparticipants had almost equal amounts of carbohydrates. When Gordon and McKinney (30) examined SBP participants, they found that SBP participants had less food energy from cereal, but more protein, fat, calcium, magnesium, and sodium from other food sources than the nonparticipants did at breakfast.

Other methods used by researchers include observation of student bag lunches (31), usual weekly intake recall from child and parent (32), weighed plate (29), and visual plate waste (27). Conway, Sallis, Pelletier, et al (31) wanted to study what middle school students were bringing in bag lunches to school. They recruited 24 middle schools (grades 6-8) and then observed bagged lunches from 1,381 students. Students were recruited before school and shortly before lunch. After agreeing to participate, students were asked to open their lunches and to remove items brought from home. Each item was viewed individually to allow a full description and students' self-reported information was used for items not easily visible, such as sandwich contents. The lunch assessors used measuring cups, spoons and rulers to estimate portion sizes (31). Conway and colleagues (31) found that half of students who brought bag lunches had lunches with more than the recommended fat content as a percent of calories. Fruit was found also in about half of the lunches, and only 5% of the lunches had vegetables and chips. Other snacks and cookies were found in 28-40% of the lunches (31).

While observing bag lunches is one approach to describe dietary intake, another approach used is a weekly intake recall from the child and parent (32). Maffeis et al (32) investigated the relationship of fat intake and adiposity of 8-11 year old children. Diet history was collected from interviews with mothers and children on usual weekly meal and snack intakes. Intake at school was assessed using school lunch menus and asking the children to identify which items and how much they consumed. The researchers found that energy intake was similar in obese and nonobese children, as determined by BMI. They also found that fat intake was not significantly different in the obese and nonobese children, but the proportion of fat in the diet was greater in children with higher relative fat mass (32).

Another method used in assessing dietary intake at school is the weighed plate method. Lee, Lee, and Shanklin (29) used this method at a rural elementary school in the Midwest. Before school meal service began, the researchers weighed the portions for entrées, vegetables, fruit, bread/grain, and dessert selections using an electronic scale.

During lunch they recorded menu items selected by students with coded trays. Then after lunch, menu items remaining on the coded trays were scraped and weighted. Data as food consumed then were entered in a nutrient analysis program (29). Lee and colleagues found that although the percentage of students eating vegetables during lunch was low, 80% of students selected a fruit at lunch. Furthermore, while the percentage of NSLP students eating vegetables was low, it was higher than those students who were not participating in the NSLP. During the study, the school lunches offered and consumed provided 16% of energy from protein, 53% from carbohydrate, 31% from fat, and 10% from saturated fat.

Another approach to collecting dietary intake can be seen using the visual plate waste method (27). Friedman and Hurd-Crixell analyzed school breakfast nutrient intake at three elementary schools in Texas. After students who usually ate school breakfast were identified, they were assigned a numbered tray. Students then selected their breakfast and when they finished eating, they left the trays on the table. Data collectors then measured remaining beverages with a calibrated measuring cup and used a visual plate waste method to determine if all, ¾, ½, ¼ or none of the food items remained on the tray. From this research, they found that the school menus met USDA requirements for breakfast protein, calcium, and Vitamin C, but provided only 80% of the energy requirement. However, the amount of total fat and saturated fat in the menus exceeded the USDA recommendations (27).

With all of these options, research shows that the most reliable method of collecting diet intake includes a combination of methods. Frequently used combinations include menu documentation of all foods offered at school meals and 24-hour recall (17, 33), and observation, menu documentation and a student survey (24). Kubik et al (17) studied the intake of seventh grade students using the 24-hour recall and documenting foods available at school. Dietary recalls were completed during school hours by trained interviewers using the Nutrition Data System (version 2.6/8a/23) at the University of Minnesota's Nutrition Coordinating Center. Students were asked to report all foods eaten during the preceding day (17). Researchers also described the school food environment and obtained production records from the school cafeteria. As described previously, they calculated the number of school lunches served and number of daily servings of fruit, vegetables (excluding fried potatoes), and fried potatoes sold. Items offered and sold to students in *a la carte* programs and snack and vending machines were recorded also (17). Kubik et al (17) found that the school *a la carte* program was significantly and negatively associated with students' fruit and vegetable consumption and positively associated with students' mean percentage of daily calories from total and saturated fat. Snack vending machines were negatively related to student consumption of fruit, while fried potatoes served at school were positively related to average total daily vegetable intake.

As part of the School Nutrition Dietary Assessment Study, Burghardt (33) also used a combination of methods, including school food documentation, 24-hour dietary recall, and an interview about USDA meal programs. First, school food service personnel provided information consisting of descriptions of foods and the amounts of foods offered as part of NSLP lunches and SBP breakfasts during a one-week time frame. This information then was converted into estimates of the average nutrients offered per meal. The researchers also collected information regarding foods offered in school, but not part of the NSLP or SBP, or those from *a la carte* and vending machines. Students in grades 3-12 received a three-part in-person interview during the school day. The three parts consisted of 1) a dietary recall with descriptions and estimated quantities of food and beverages consumed during the prior 24-hours, and identification of location where each food was consumed and its source food (school, home, other, etc); 2) questions about foods eaten at school that were either selected or served and how much was consumed to determine participation in the USDA programs; and 3) questions about perceptions of the USDA meal programs, the student's age and family characteristics. Students in grades 1-2 were interviewed briefly only about foods consumed at school and later that day the students were interviewed with a parent or guardian, where all other foods were recorded (33).

One final combination of observation, menu documentation, and a student survey can be seen in the study by Zive, Elder, and Prochaska (24). These researchers collected information from 24 middle schools (grade 6-8) in California. As part of the study, a five-day period was randomly sampled for each school. In those five days researchers collected detailed information on all food items sold as part of the NSLP lunch or SBP breakfast, description of each food, source of food item, serving size, number of students served, and total fat and saturated fat per serving. In addition, food descriptions for *a la carte* items and foods available at the student store were collected. During three days, assessors observed the contents of bag lunches that were brought to school. Students who consented to participate were asked to show their food and beverages from the bag lunch and asked to clarify food items. Students were selected randomly to complete a survey anonymously at home on school food practices (i.e. bringing a bag lunch). Zive et al (24) found that the average student consumed about 26 g of total fat at school, which was 30% higher than the recommended 20 g (based on 30% of calories from fat for a 2000 kcal/day diet with 33% of requirements consumed during school lunch). Also Zive et al (24) reported that all students were exposed to a "school food environment with excessive fat."

While the 24-hour recall is a popular method of collecting dietary intake, there is concern about the accuracy of the recall. Domel (34) studied two 24-hour recall methods compared to what the fourth grade students were observed consuming. One method was to allow the fourth grade student to free report all foods eaten and then the researcher repeated the student's food list back to the student and the student was asked if any other food items had been consumed (nonintegrated). The other method asked the student to report foods eaten along with location of consumption and then they were prompted for other foods consumed (integrated). Domel found that the nonintegrated style produced fewer omissions and significantly higher accuracy after prompting. When studying children's intakes it is important to utilize multiple methods in collecting dietary data. The validity of a study increases when a variety of methods are used in collecting dietary data (34).

Impact of NSLP and SBP on Nutrient Intake

Gleason and Suitor (26) found that participation in the NSLP is associated with a greater intake of food energy and a number of vitamins and minerals, including vitamin A, thiamin, riboflavin, vitamin B_6, vitamin B_{12}, folate, calcium, phosphorus, magnesium, iron, and zinc. NSLP participants (those that report consuming 3 of the 5 meal components) consumed an average of 30% of the Recommended Energy Allowance at lunch whereas non-participants consumed only 26%. The difference persisted over the entire day. NSLP participants also had higher intakes of cholesterol, total and saturated fat (expressed as percentage of calories) (26). The School Nutrition Dietary Assessment Study (28, 35) found similar results to that of Gleason and Suitor. This study found that the average dietary intake of students met the Recommended Dietary Allowance but that students participating in the NSLP consumed more food energy, protein, fat and sodium than recommended. NSLP participants consumed at least one-third of the RDA for food energy and all vitamins and minerals, whereas the non-participants consumed less than one-third of the RDA for food energy, vitamin A, vitamin B_6, calcium, iron, and zinc (35).

When considering the SBP, Burghardt, Devaney and Gordon (11) found that the program provided 31% of calories from total fat (slightly above the 30% recommendation of the Dietary Guidelines for Americans (36)) and 14% of calories from saturated fat (well above the 10% recommended by the Dietary Guidelines for Americans (36)). SBP participants consumed more energy from breakfast than those students who ate breakfast at home. However, the average student nutrient intake of specific vitamins and minerals per kilocalorie was relatively the same for participants and non-participants. When considering the entire day, SBP contributed to higher food energy intake and higher intakes of protein and calcium, but had no influence on other dietary components compared to those who did not participate in the SBP (11).

In studies other than the School Nutrition Dietary Assessment, similar findings of the impact of NSLP and SBP have been seen. In a report from the USDA on Children's Diets in the Mid-1990's, NSLP participation was associated with higher mean intakes of food energy, vitamin B_6, vitamin B_{12}, thiamin, riboflavin, calcium, phosphorus, magnesium, and zinc. Many of these differences occurred at both lunch and over 24 hours. NSLP participants consumed higher mean total fat, saturated fat, and sodium, and lower intakes of added sugars than non-participants. These intakes occurred for lunch and persisted throughout the day. SBP participants consumed higher quantities of food energy, calcium, phosphorous, and vitamin C. When students participated in both the NSLP and the SBP, they were more likely to meet the dietary standards for vitamin C, vitamin B_6, vitamin B_{12}, thiamin, riboflavin, calcium, iron, magnesium, phosphorous, and zinc. However, NSLP and SBP participants were also more likely to exceed the fat and sodium guidelines (25). Friedman and Hurd-Crixell (27) investigated the food environment in relation to SBP and the nutrient intake of children eating school breakfast. They found that SBP menus met the USDA requirements for protein, calcium, vitamin C, vitamin A and iron. However, the SBP exceeded the percentages of fat and saturated fat recommended by the USDA. When examining student intake, SBP participants consumed less energy, but still had too much saturated fat (27).

Another study evaluated school breakfast club participation and the impact on student nutrient intake. Belderson et al (37) found that participating in a school breakfast club led students to have lower energy and carbohydrate intakes, but higher fat intakes overall. The students also had higher sodium intakes, but lower calcium and iron intakes than students not participating in a school breakfast club (37). Nicklas, Morales, Linares, et al (38) found that with the introduction of the school breakfast program, the number of children skipping breakfast decreased. Children in the study who ate breakfast had better overall dietary intakes when compared to those who skipped breakfast (38). Given the various dietary intake differences in children who participate in the SBP and those who do not it is also important to consider body weight differences that may occur between the two groups.

Children's Weight

According to the Centers for Disease Control and Prevention (CDC), body mass index (BMI) determines weight status for children by age and gender (12). BMI is plotted on a gender specific growth chart and determined by measuring a child's weight in kilograms divided by height (m) squared (kg/m^2) (3). In children, at risk for being overweight is determined by a BMI-for-age equal to or above the 85th percentile and below the 95th percentile BMI-for-age. Childhood overweight is categorized by a child having a BMI-for-age equal to or above the 95th percentile BMI-for-age (12). Results from the 1999-2000 National Health and Nutrition Examination Survey (39) indicated that approximately 15% of children and adolescents are now overweight. However, little is known about children's weight status in relationship to dietary intake.

Breakfast Impact on Children's Weight

While study results vary, there has been some research in the area concerning breakfast consumption and its impact on child weight. Nicklas, Morales, Linares, et al (38) found that while children who ate breakfast had better dietary intakes than children who skipped breakfast, the study found no association of breakfast consumption and weight. A recent review of literature by Rampersaud, Pereira, Girard, et al (4) found breakfast consumption in children declined from 1965 to 1991. The review also found that energy and macronutrient intakes from breakfast consumption varied and were influenced by characteristics of the population (food consumed, where breakfast was eaten, study location). Increased consumption of low-fat milk, ready-to-eat cereals, and juices and decreased consumption of high-fat milk, whole-grain breads, and eggs were reported. In regards to weight Rampersaud et al (4) found that children who consumed breakfast had an approximately 30% lower odds of being overweight. Overweight children were more likely to skip breakfast when compared to their normal or underweight peers (4).

A prospective study, using children from the Growing Up Today Study, found that normal weight and overweight children who skipped breakfast had lower energy intakes compared to those who ate breakfast. However, the study did suggest that heavier children skipped breakfast (40). Several other studies found similar results that children who skip breakfast tend to be heavier than children who eat breakfast (8, 41-42). Boutelle et al (41) found that usual breakfast consumption was inversely related to overweight status. The study suggested that overweight adolescents might skip meals as a way of managing their weight, but the data suggest that this strategy is inappropriate for weight reduction.

Wolfe et al (7) found multiple factors contributed to children's weight in their study of overweight in schoolchildren in New York. For example, children from single-parent families were thinner than those from two-parent families, while children who participated in the school lunch program and children with multiple siblings were fatter. One final factor contributing suggested by Wolfe et al (7) to child weight was breakfast consumption, whereby children who skipped breakfast tended to be fatter than those who ate breakfast. Finally, Dwyer et al (42) found very similar results when studying adolescents' eating patterns. They reported that overweight children were more likely to omit breakfast and to eat two rather than more meals a day when compared to those who were not overweight. While these studies all point towards a relationship between breakfast skipping and overweight, none have examined breakfast consumption location in relation to weight.

Summary

Multiple studies exist that examined various aspects of the school food environment, and have been discussed in the previous sections. Given the variety found in the literature, it is important to understand why the research described on this thesis advances the understanding of the impact school breakfast may have on children's weight status. First, studies have found that students who eat breakfast at school have increased amounts of energy and fat (11, 25, 27). Research also has shown that students consume between

35% and 40% of their total energy at school (15). Thus, a part of the energy derived from school meals could be from breakfast, which, as discussed previously has been shown to contribute more calories and fat than breakfasts consumed at home. Studies have shown that overweight children tend to skip breakfast (4, 7, 41-42). While previously published studies investigated breakfast's contribution to nutrient intake and the impact skipping breakfast may have on children's weight status, research has not examined the relationship of breakfast location on weight. It is important to examine where children eat breakfast (e.g., at school or home) to determine if breakfast location has any impact on dietary intake and weight. This researcher hypothesized that children who eat breakfast at school would have higher BMI because of the increase in fat and energy consumed at school breakfasts.

Research Questions

Over time, it will be vital to assess all aspects of children's diets. However, this research narrowed the view to the school food environment, including energy, fat, saturated fat, and fiber and their relationships to weight status of students. As part of this goal, this study addressed specifically the School Breakfast Program and its contribution to children's dietary intake and relationship to weight status. The subject group consisted of fourth grade children at five schools in a rural East Tennessee County. Specifically this research:

1. Described the overall school breakfast environment at five schools as a group, in terms of energy (kcal), total fat (g, % of energy), saturated fat (g, % of energy),

and fiber (g), derived from foods purchased from the school breakfast choices offered (expressed on a per person per day basis).

2. Compared consumption of energy (kcal), total fat (% of energy), saturated fat (% of energy), calcium (mg), iron (mg), vitamin A (RAE mcg), vitamin C (mg), and fiber (g) of children who ate breakfast at home, those who are breakfast at school, and those who ate breakfast at home and school.
3. Compared contribution of breakfast to the entire day's intake expressed as percent contribution for energy (kcal), total fat (% of energy), saturated fat (% of energy), calcium (mg), iron (mg), vitamin A (RAE mcg), vitamin C (mg), and fiber (g) for children who eat breakfast at home, school, or both.
4. Compared consumption of energy (kcal), total fat (% of energy), saturated fat (% of energy), calcium (mg), iron (mg), vitamin A (RAE mcg), vitamin C (mg), and fiber (g), of children who were not at risk for overweight ($< 85^{th}$ BMI percentile), those at risk for overweight ($\geq 85^{th}$ BMI percentile to $< 95^{th}$ BMI percentile), and those overweight ($\geq 95^{th}$ BMI percentile).
5. Compared children who ate breakfast at home, those who ate at school, and those who ate at home and school by weight status (not at risk of overweight, at risk of overweight, and overweight).
6. Analyzed if breakfast source (home, school, both) and nutrient status (energy, fat, saturated fat, calcium, iron, vitamin A, vitamin C, and fiber) increased the likelihood of students being at risk for or overweight.

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Part II

School Breakfast Environment in Four Rural Appalachian Schools: Biscuits, Sausage, Gravy, Milk, and Orange Juice

Introduction

Evaluation of the school food environment provides a means of understanding how the environment influences what children eat at school. Studies have examined the school food environment to help develop environmental interventions to influence food intake positively and ultimately the nutritional status of children. Most of this research has been conducted on schools participating in the National School Lunch Program (NSLP) (1-5).

Using school-level production records at 16 schools in the St. Paul – Minneapolis area, Kubik and colleagues (1) assessed the school lunch environment in relation to the NSLP requirements, *a la carte* options, snack and beverage vending and school stores. Foods were grouped according to "foods to limit" or "foods to promote." Results revealed that students with access to *a la carte* programs exceeded the USDA daily recommendation for fat, while those without access did not. The study also found a statistically significant negative association with snack vending machines and student intakes of total daily average servings of fruits (1).

Another study took a similar approach by documenting all foods available at school during lunch (2), but focused on foods available as *a la carte* and through vending machines. In this study combined items from the chips/crackers and ice cream/frozen desserts categories accounted for 21.5% of *a la carte* foods consumed, while fruits and vegetables only accounted for 4.5%. Two thirds of the schools had soft drink vending machines. French et al (2) expressed concern for these findings, which supported other studies (6-10) showing that adolescents consumed 35% to 40% of their total energy intake at school with a large portion of this attributed to *a la carte* foods and vending machines items (2).

Other studies have depicted the food environment excluding the NSLP also and looked at *a la carte* items, school stores and vending machines in middle schools (grades 6-8) (11). Wildey et al (11) specifically studied the fat and sugar content of foods purchased by students at school stores and found that in just one-week students at 13 schools bought nearly 10,000 snack food items. The average snack item provided 8.7 g fat and 23.0g sugar per serving.

While multiple studies exist for the school lunch environment, very few studies have described the school breakfast environment. An estimated 7.3 million school children participate in the School Breakfast Program (SBP) every day (12). Participation is associated with higher intakes of energy, calcium, phosphorus, vitamin C (12), and protein (3). Designed to provide one-fourth of the RDA (3, 13, 14), the SBP has the potential to be an important factor in children's dietary intakes. This study examined the school breakfast environment of four rural Appalachian schools to evaluate the SBP's potential contribution to calorie, fat and fiber intake.

Methods

Subjects

Five schools were selected based on student participation in a community trial of the "Youth Can! Improve Their Diets for a Healthy Heart" study (Youth Can!). Youth Can!

is a 2-year study of fourth and fifth graders in a rural East Tennessee county. Breakfast production and sales data were available from four elementary schools and one intermediate school. However, one school was dropped for this study, because of incomplete and missing data. To make this decision, two methods were considered: (1) data from one day with complete data substituted for the missing day; and (2) synthetic estimation by applying the average of data for the complete days. However, neither option could reliably produce a synthetic value for orange juice servings, because the school failed to record orange juice data on any day. Therefore, the school in question was dropped from the school breakfast environment analysis.

Menu Documentation

Menu documentation was used to measure the school nutrition environment on a per person basis as calories, total fat, saturated fat, and fiber served. Methods for the menu documentation were based on the Child and Adolescent Trial for Cardiovascular Health (CATCH) (4) and a study of school food service environments by Zive et al (5).

Data for the menu documentation were available from the Youth Can! study. Youth Can! researchers collected 18 days of breakfast and lunch menus and interviewed food service managers at the study schools. Once menus were collected, food service managers were re-interviewed for recipes and additional foods served, but not listed on the menu. Youth Can! research staff used production sheets provided by the schools to determine serving sizes and how much of each item was served. Food item bid sheets from the school vendors provided exact specification for foods available for purchase. Food service staff were interviewed again to confirm ingredients used in mixed dishes and foods that were prepared on site. All food items data for the breakfast menus were entered in Nutrient Data Systems for Research (NDS-R) database. For mixed dishes and food prepared on site Youth Can! research staff matched foods in NDS-R that had similar composition.

In the current study production sheets from Youth Can! were used to determine the amount of each food item served at breakfast, which in turn was used to describe the school food breakfast environment on a per person basis. NDS-R was used to calculate energy, fat, and fiber content of the menus. The resulting dataset was exported to a SPSS data file and analyzed for energy (kcal), total and saturated fat (g, % of energy), and fiber (g). From the analysis, the school food breakfast environment was defined on a per person basis. The food items in the data set were also grouped by USDA meal components and then ranked according to highest amount of servings. The following details the menu documentation protocol:

- Breakfast and lunch menus collected for 18 days;
- Food service managers interviewed to confirm menus and collect recipes if available;
- Production records and product bid sheets used to determine serving sizes and types of foods ordered; bid sheets provided exact specifications for foods (i.e. weights of foods);
- Items offered as self-serve assigned standard serving sizes (i.e. French fries would equal ½ cup);

- School meal participation forms used to assess number of breakfasts and lunches served;
- School menus, manager interviews and production sheets compared to identify any missing foods;
- Food service managers interviewed again with further questions regarding food items and preparation methods;
- Kitchen staff contacted regarding information needed on food items prepared from multiple ingredients; recipes obtained when available or staff questioned on specific amounts of ingredients used in mixed or prepared dishes.

Results

The school breakfast environment at the four rural Appalachian schools provided 540 calories, 26 grams of fat, 9 grams of saturated fat, and 2 grams of fiber per person (Table 1). More than 40% of the calories were from fat (43%), while 15% were from saturated fat. For three of the five USDA meal components high fat foods were ranked highest for total servings (Table 2). Sausage and scrambled eggs topped the meat/meat alternative category, biscuits had the highest number of servings for the grain component, reduced fat milk (2%) was first in the milk component and orange juice was served the most in the fruit/vegetable/juice component. Breaded chicken patties, granola bars, skim milk, and fresh bananas were served the least in the meal components, respectively. Gravy was also a highly served food; however it does not belong in any of the USDA meal components.

Table 1: School Breakfast Environment (Averaged per Person per Day) Derived from 18 Days of School Food Sales Records						
School Breakfast Environment per Person[1]	Grams			% Calories		
	Mean	±	SD	Mean	±	SD
Fat	26.47	±	11.00	43.08	±	8.42
Saturated Fat	9.18	±	3.89	14.92	±	3.04
Fiber	1.96	±	0.50	NA[2]		

[1] Average total calories per person for school breakfast = 535.16 ± 139.38 calories.

[2] Not applicable

Table 2: School Breakfast Food Environment Grouped by USDA Meal Components and Ranked by Total Servings Served (Highest to Lowest) Over 18 Days of Breakfast

Meal Component	Total Servings
Grains/Breads	
Biscuit - baking powder or buttermilk, prepared from refrigerated dough	1734
Cereal, dry	412
Oatmeal, quick cooking	174
Doughnut, cake, regular, glazed, plain	84
Doughnut, cake, regular, plain	67
Danish pastry, with frosting or glaze, plain or with spices	24
Pop tart, regular	22
Granola bars, Kellogg's Nutri-Grain Cereal Bars - all flavors	13
Meat/Meat Alternative	
Sausage, breakfast or brown and serve, pork	647
Scrambled egg, plain	410
Bacon, breakfast strips, pork	290
Ham, dry cured (country style), no visible fat eaten	252
Chicken, commercial pre-breaded, nuggets or sticks	145
Ham, patty	127
Ham, regular cured, unknown type, no visible fat eaten	79
Chicken, commercial pre-breaded, patty	47
Milk	
Milk, 2% fat or reduced fat	673
Milk, chocolate, 1% fat or low fat	358
Milk, whole (3.5 - 4% fat)	94
Milk, skim, nonfat or fat free	78
Juice/Fruit/Vegetable	
Orange juice, purchased ready-to-drink	1238
Apple, applesauce or stewed apples, canned, unsweetened	206
Fruit, fruit cocktail, canned, syrup pack, light	80
Apricot, canned, syrup pack, light	50
Fruit, mixed fruit, canned, syrup pack, light	36
Peach, canned, syrup pack, light	25
Banana, fresh or ripe	9
Other	
Gravy, pork, prepared from dry mix	690

Discussion

The SBP guidelines state that school breakfast should consist of no more than 30% of calories from fat and less than 10% calories from saturated fat (14). The schools in this study exceeded the SBP guidelines for calories from fat and saturated fat (43% and 15%, respectively). Baseline results from the CATCH study found that on average school breakfasts provided 31.3% and 14.9% of calories from fat and saturated fat, respectively (15). Similar results were found in the School Nutrition Dietary Assessment Study (16) and a study by Friedman et al (17). Results from all these studies reveal that school menus consistently provide amounts of fat and saturated fat higher than dietary recommendations.

However, reducing the fat intake may be a challenge. Following completion of the current study, the school vendor bid sheets were examined for comparable low-fat options for the foods served at breakfast. The bid sheets were found to have no comparable low-fat options for the breakfast items served. Pannell (18) postulated that school meals are high in fat for several reasons:

1. USDA-donated commodities, including high fat butter and cheese, are available to schools in unlimited quantities.
2. Food preparation also contributes to the high fat content. Restaurants have set a "standard" that certain foods should be fried and heavily greased (French fries, fried chicken, high-fat hamburgers, pizza). Marketing campaigns target the children who then want similar types of foods offered at school.

3. Another suggested reason for school meals to be high in fat is cost and revenue. The convenience of processed foods reduces labor costs, but increases hidden fat. Lower-fat options typically cost more than convenience foods and when offered, lower-fat options often do not sell as well as more popular high-fat options.
4. Food service directors have been trained to meet Recommended Dietary Allowances but not necessarily goals for fat and cholesterol (18).

Even though the fat content of the school breakfasts was high (43% and 15% of calories from fat and saturated fat, respectively), the total calories (539) were slightly less than the SBP guidelines of 554 calories per person (19). Others have found also that schools fall short of meeting the energy requirement for breakfast (16-17). The current study revealed available energy of breakfast meals closer to the SBP guidelines than previous studies. It is possible that this requirement is met through the higher fat content of the meals.

While the SBP does not have specific guidelines for fiber content, the Appalachian schools provided about 2 grams of fiber. This is slightly higher than reported by Friedman et al (17), who found school breakfast to provide 1.24 grams of fiber per person. The Dietary Reference Intakes (DRIs) for children 9 to 13 years of age range from 26 grams of fiber for females to 31 grams for males (20). School menus would need to provide roughly 6 to 8 grams of fiber at breakfast to meet the recommended intakes. Ways to increase fiber content of school breakfast include replacing some of the refined grains with whole-wheat grains and serving more fresh fruit instead of juice (17).

Of particular interest are the types of foods that composed breakfast in the study schools. The top ranked foods for servings sold for SBP meal component were biscuits, sausage, 2% milk, orange juice and gravy. When examining the meat/meat alternative breakfast options, it was observed that most were high fat options. Food vendor bid sheets provided very few low-fat meat/meat alternatives for the schools to purchase in post hoc analysis. Similarly very few low-fat grain options were available for purchase. This situation leaves the school food service managers with the option to order prepared food items that are high in fat foods, to prepare low-fat foods from scratch, or to limit the variety of option offered with in the meat/meat alternative and grain components. Preparing foods from scratch is more labor intensive and expensive, requiring a larger school breakfast budget and limiting the variety of foods available might reduce participation in the SBP.

One limitation of this study was that results were reported per person and not per child as previous studies have done. Production sheets from this study's schools did not separate adult meals from student meals and thus reporting per child was impossible. Another limitation of this study is that the results cannot be generalized to other populations due to the small number of study schools and the lack of randomization of study days. Production sheets were collected for all days that student dietary recalls were recorded. However day selection was based on days that schools were available for dietary data collection. However there is no reason to believe that the days selected were atypical or systematically different from other days.

Conclusion

From this study, the school breakfast environment provided 97% of the SBP guidelines for energy, but exceeded the guidelines for fat and saturated fat, by 13% and 5% respectively. Based on the meal component rankings, the items that were served the most tended to be higher fat foods. Future research should examine the relationship of the school breakfast environment to students' individual intake. This will assist researchers in knowing if what is served at school is completely consumed or whether students only eat part of what is served. Further research is also needed to determine if the higher fat intake of SBP participants persists throughout the day or if they compensate at other meals for the high fat breakfast.

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Part III

The Relationship of School Breakfast Participation in Dietary Intake and Weight among Rural Appalachian Fourth Graders

Introduction

One in three children in the United States is either at risk for overweight or overweight (1). In Tennessee, more than 20% of children are overweight with an additional 25% at risk for being overweight. Research has shown that childhood overweight is increasing. Mokdad et al (2) found that "Overweight would account for the major impact of poor diet and physical inactivity on mortality" (p. 1240). Poor diet and physical inactivity have had the largest increase of all actual causes of death and the number is likely to rise when the full impact of current rates of overweight and obesity is manifested in increased chronic disease rates (2). Large numbers of overweight children will remain overweight in their adolescent years and into adulthood, making childhood and adolescence two critical periods for the development of overweight (3).

An estimated 7.3 million schoolchildren participate in the School Breakfast Program (SBP) every day (4). Nearly 1 in 10 are consuming 2 of their 3 major meals at school and more than half are consuming 1 of their 3 major meals at school (5). Between 35 to 40% of students' total daily energy is consumed at school. Thus the school environment has the potential to significantly impact children's dietary intake (6). The School Nutrition Dietary Assessment Study found that participation in the SBP provides 31% and 14% of breakfast calories from total fat and saturated fat, respectively, and that children who eat at breakfast at school consume more energy than those who eat at home. SBP participants also receive higher food energy intake and higher intakes of protein and calcium per day compared to non-participants (7). Other studies have found similar results with higher intake of energy, calcium, Vitamin C (4), saturated fat (8), total fat and sodium (9) associated with participation in the SBP.

SBP participation has been defined as foods consumed at breakfast at a school participating in the SBP (8) and as students who obtained at least two of the SBP meal-pattern requirements (10). Breakfast intake has been described as everything a child eats from the time he/she awakes until 45 minutes after school starts (10). Children who eat breakfast, regardless of location, typically have dietary intakes closer to recommended dietary guidelines compared to children who skip breakfast (11). However, studies also have found that children who skip breakfast tend to have lower energy intakes, but greater body weight (12-15).

Little is known about how dietary intakes and weight status differ by where children eat breakfast. Therefore, given the established impact school breakfast has on children's dietary intake and the increasing rates of childhood overweight, this study evaluated how dietary intakes differed by where children ate breakfast and by their weight status and how weight status differed by where children ate breakfast. The study population was from a rural Appalachian county where 46% of the school children are either at risk for overweight or overweight (16).

Methods

Data for this study were from a community trial called "Youth Can! improve their diets for a healthy heart" (Youth Can!). Youth Can! is a 2-year study of fourth and fifth graders in a rural East Tennessee County. The two main goals of Youth Can! are: 1) to collaborate with fourth grade students and fifth grade teachers to develop a fifth grade nutrition intervention (youth leadership and nutrition education) to reduce the prevalence of overweight and improve dietary behavior; and 2) to conduct a school-based trial of the impact of the intervention on weight status of fifth grade students compared to nutrition education alone or weight monitoring alone. Baseline data in year 1 (height, weight, food survey, and a 24-hour dietary recall) were collected at five schools from fourth grade students. Youth Can! will track the students for two years to evaluate impacts the project has on weight status and diet, and to examine the influences student leadership teams have on the school food environment.

Baseline data from 255 4th grade students were collected. Initial analysis was completed on daily caloric intake using stem-and-leaf plots to control for outliers at values greater than or less than two standard deviations of the mean for daily caloric intake. Applying this criterion, 11 students were eliminated who had daily caloric intakes less than 200 or more than 4000 calories. An additional 27 children were eliminated for analyses using weight status, because of missing height (n = 27) and weight (n = 27) measures. Age was undeterminable for the same 27 subjects, because date of birth was asked at the same time height and weight were measured. Therefore, a total of 244 subjects were included for analyses of breakfast and daily intake and breakfast location, while 217 subjects were included for analyses of weight status and breakfast intake and location.

All schools in the county school system with fourth and fifth grade classrooms (n = 5) are included in the Youth Can! study. Each school also participates in the SBP and the NSLP. Approximately 14% (14.2) of students who eat breakfast at school receive it free or at a reduced priced. This rate is slightly lower than the 16.6% of students across Tennessee who receive a free or reduced price breakfast (17). A total of 350 students were invited to participate in the study with 256 students actually participating (73%). The overall Youth Can! project was approved for human subject research by the university's Internal Review Board.

Youth Can! Measures

<u>Breakfast Location</u>

Participating children were asked an open-ended question about the location of each eating occasion during the 24-hour dietary recall. The children were classified into three groups based on their answer to the question "Where did you eat this?" This question was directed to all eating occasions that occurred between the time the child awoke and 45 minutes after school started. If the child's response was "school," then the child was assigned to the SBP group (school). If the response was "home, in the car, or some place other than school," then the student assignment was the home breakfast group (home). If the child's response was "school and somewhere else," the child was assigned to the breakfast at school and home group (both). If the child did not consume anything from the time he/she awoke until 45 minutes after school started, the child was assigned to the "no breakfast" group. In the current study only children who ate breakfast were examined.

Nutrient Intake for Breakfast and the Entire Day

Using the USDA automated multiple pass protocol, a 24-hour food recall was performed with each child to assess nutrient intakes (18). During the first pass of the dietary recall interview, the interviewer asked the student to list all foods consumed and the time and location for each eating occasion. In the second pass the interviewer reviewed the list of foods and asked the student to recollect eating or drinking any other items. On the last pass, the interviewer asked the student details about each food item, including how much was consumed, how the food was prepared, and what type of food it was (e.g. percent fat for milk). As students verbalized their responses, the interviewer entered the dietary data directly into the NDS-R software (version 4.06_34, Nutrition Coordinating Center, University of Minnesota) interview screen using a laptop computer.

Weight Status

As part of the school system's Coordinated School Health Program, the weight and height of each fourth grade student was measured. Children were weighed three times on a calibrated digital scale with each recorded weight rounded to the nearest 0.1 kilogram. The height (cm) for each child was measured using a stadiometer.

Child-Level Data

Nutrient Intake

Nutrient intake for each student was reported as food energy (kcal), total and saturated fat (% of energy), calcium (mg), iron (mg), Vitamin A (mcg), Vitamin C (mg), and fiber (g). NDS-R nutrient analysis program was used to analyze nutrient intakes for breakfast and the 24-hour period. Data collection occurred on Tuesday, Wednesday, Thursday, or Friday to ensure that the students had an opportunity to eat breakfast at school the day before.

Weight Status

Each student's body mass index (BMI) was calculated from the weight and height measures using the CDC approved formula of weight (kg) divided by height (m) squared. BMI percentiles were obtained by using NCHS growth references (19). Based on calculated BMI results, children were sorted into three groups: those that were not overweight ($<85^{th}$ BMI percentile), those at risk for overweight ($\geq 85^{th}$ to $<95^{th}$ BMI percentile), and those who were overweight ($\geq 95^{th}$ percentile). Student BMI data were calculated in SPSS 13.0 for Windows and then grouped according to the calculated BMI.

Analyses

NDS-R was used to estimate nutritional composition of the foods consumed. NDS-R output for nutritional composition was exported to SPSS for statistical analysis. Comparisons among the dietary intakes by breakfast location and by weight category were conducted using means testing and Analysis of Variance (ANOVA). Chi square testing was used to compare breakfast location and the children's weight status.

Results

Most (91%) of the students participating in this study ate breakfast. Nearly half of the students ate breakfast at home (48%), one fourth ate breakfast at school (26%) and almost one fifth of the students ate breakfast at both home and school (18%). More than half were not at risk for overweight (55%), while a combined 45% were at risk for overweight (20%) or overweight (25%) (Table 3). Comparison of breakfast location to weight status indicated that breakfast location did not make a measurable contribution to weight status (Table 4). Further investigation of weight status and dietary intake found no relationships between dietary intake from breakfast and weight (Table 5). Although participation in SBP did not directly contribute to overweight, additional evaluations of dietary intakes (entire day and breakfast only) were conducted to detect differences among children eating breakfast at school, home, and both locations. Specific parameters evaluated included total energy intake measured as calories, total fat, saturated fat, protein, vitamins A and C, calcium, iron, and fiber.

Total Day's Intake

Children who ate breakfast at both home and school had significantly higher daily calorie intake compared to children who ate breakfast only at school. Vitamin A intake for the entire day was significantly lower for children who at breakfast at school compared to those who ate breakfast only at home or at both places (Table 6). No other significant differences were detected among the groups.

Breakfast Intake Comparisons

Although the daily intakes differed among groups in only total calories and vitamin A, several differences were detected among the groups when only breakfast intake was examined (Table 7). The results revealed that children who ate breakfast at both home

Table 3: Characteristics of the Study Population[1]			
		Total	% of population
Gender[1]	Male	118	48.4
	Female	126	51.6
Ages[1]	9	170	78.3
	10	45	20.7
	11	2	0.9
School[1]	1	10	4.1
	2	17	7.0
	3	55	22.5
	4	112	45.9
	5	50	20.5
Consumption of Breakfast[1]	Yes	223	91.3
	Home	116	47.5
	School	65	26.6
	Both	42	17.2
	No	21	8.6
BMI Categories[1]	Not at risk for overweight	120	55.3
	At risk for overweight	42	19.3
	Overweight	55	25.3

[1] Percentage of population based on valid number of participants for each variable and for whom daily caloric intake was within 2 standard deviations of mean, excludes missing data
Total n = 244 for gender, school, and consumption of breakfast
Total n = 217 for age and BMI categories

Table 4: Breakfast Consumption Location by BMI Classification[1].

Breakfast Location		BMI Classification[2]			
		Not at Risk	At Risk	Overweight	Total
Home	Count	56	20	29	105
	% within BMI Classification	52	53	59	54
School	Count	27	13	12	52
	% within BMI Classification	24	34	24	26
Both	Count	26	5	8	39
	% within BMI Classification	24	13	16	20
Total	Count	109	38	49	196
	% within BMI Classification	100	100	100	100

[1]Total n = 217, excludes missing height and weight data and those whose daily caloric intake was greater than or less than 2 standard deviations of the mean.

[2] BMI classification: Not at risk - <85th BMI percentile, At risk - $\geq$ 85th & <95th percentile, and Overweight - $\geq$ 95th percentile

No statistical significance at $p < 0.05$ for Chi-Square analysis.

Table 5: Breakfast intake by BMI Classification[1]

Breakfast Intake	BMI Classification[2]								
	Not At Risk			At Risk			Overweight		
	Mean	±	SD	Mean	±	SD	Mean	±	SD
Energy and Macronutrients									
Calories	371.98	±	242.20	367.53	±	282.15	354.19	±	237.30
% Calories from Fat	25.88	±	15.19	26.11	±	18.67	26.29	±	15.99
% Calories from Saturated Fat	10.35	±	6.62	10.08	±	7.39	10.49	±	7.10
Protein (g)	11.31	±	9.63	11.17	±	9.73	11.35	±	9.20
Micronutrients									
Calcium (mg)	254.65	±	288.28	226.81	±	194.99	250.23	±	242.55
Iron (mg)	4.12	±	4.03	3.39	±	2.89	3.36	±	3.28
Vitamin A (RAE mcg)	197.66	±	236.63	176.25	±	165.11	207.48	±	198.51
Vitamin C (mg)	23.58	±	33.30	26.04	±	35.33	18.32	±	44.52
Fiber									
Fiber (g)	1.64	±	1.43	1.54	±	1.27	1.60	±	1.68

[1]Total n = 217, excludes missing height and weight data and those whose daily caloric intake was greater than or less than 2 standard deviations of the mean

[2] BMI classification: Not at risk - <85th BMI percentile, At risk - $\geq$ 85th & <95th percentile, and Overweight - $\geq$ 95th percentile

No statistical significance at $\alpha = .05$

Table 6: Total Day's Intake by Breakfast Consumption Location[1]									
Day Intake	Total Day's Intake								
	Breakfast Location								
	Home			School			Both		
	Mean	±	SD	Mean	±	SD	Mean	±	SD
Energy and Macronutrients									
Calories	2138.40	±	662.89	2006.04	±	717.56[b]	2349.74	±	684.10[s]
% Calories from Fat	33.38	±	7.49	34.22	±	5.43	34.53	±	6.35
% Calories from Saturated Fat	13.15	±	3.73	12.97	±	3.44	12.75	±	3.79
Protein (g)	74.45	±	29.98	71.03	±	31.89	80.39	±	29.68
Micronutrients									
Calcium (mg)	1125.05	±	564.86	1069.37	±	570.29	1164.49	±	575.66
Iron (mg)	247.25	±	90.96	241.72	±	82.09	275.57	±	92.98
Vitamin A (RAE mcg)	769.39	±	392.97[s]	629.25	±	319.80[h,b]	838.67	±	421.14[s]
Vitamin C (mg)	50.30	±	69.70	42.98	±	28.91	67.69	±	52.80
Fiber									
Fiber (g)	13.29	±	6.38	13.84	±	5.46	15.84	±	7.40

[1]Total n = 244, excludes those whose daily caloric intake was greater than or less than 2 standard deviations of the mean

h = different from "Home", s = different from "School" and b = different from "Both". The differences are statistically different at $\alpha = .05$

Table 7: Breakfast Intake by Breakfast Location[1]			
Breakfast Intake	Breakfast Location		
	Home	School	Both
	Mean ± SD	Mean ± SD	Mean ± SD
Energy and Macronutrients			
Calories	360.17 ± 211.99^{b}	384.54 ± 182.39^{b}	547.54 ± 252.10^{h,s}
% Calories from Fat	25.02 ± 14.75^{s}	34.34 ± 14.53^{h}	29.51 ± 11.90
% Calories from Saturated Fat	10.60 ± 6.76^{s}	12.98 ± 5.52^{h}	10.93 ± 4.98
Protein (g)	10.59 ± 8.27^{b}	13.44 ± 6.96	16.91 ± 11.66^{h}
Micronutrients			
Calcium (mg)	254.16 ± 221.94^{b}	248.20 ± 158.76^{b}	385.75 ± 385.26^{h,s}
Iron (mg)	4.83 ± 4.34^{s}	2.96 ± 1.55^{h,b}	4.81 ± 3.56^{s}
Vitamin A (RAE mcg)	244.67 ± 239.41^{s}	144.42 ± 114.71^{h,b}	253.21 ± 207.91^{s}
Vitamin C (mg)	20.42 ± 38.26	27.19 ± 30.08	35.69 ± 41.07
Fiber			
Fiber (g)	1.67 ± 1.50^{b}	1.62 ± 0.90^{b}	2.41 ± 1.70^{h,s}

[1]Total n = 244, excludes those whose daily caloric intake was greater than or less than 2 standard deviations of the mean

h = different from "Home", s = different from "School" and b = different from "Both". The differences are statistically different at $\alpha = .05$

and school had significantly higher intakes of calories, calcium, and fiber when compared to children who ate only at home or only at school. Children eating breakfast at both home and school also consumed significantly more protein than those who only ate at home. Children who ate only at school had higher intakes of fat and saturated fat (% of calories) than children who only ate at home. Breakfast consumption only at school was related to lower intakes of iron and vitamin A compared to breakfast consumption only at home and at both places (Table 7).

Breakfast Contribution to Entire Day's Intake

Results show differences in breakfast intake by breakfast location and a few differences in the entire day's intake. However, there are several significant differences in how breakfast contributes to the entire day's intake based on breakfast location. The degree to which breakfast contributed to the entire day's intake of calories and calcium was significantly greater for children who ate breakfast at both home and school compared to those who ate only at home or at school (Table 8). Furthermore, breakfast's contribution to the day's protein and fat intake was significantly less for those who ate at breakfast only at home compared to those who ate only at school or at both places. For students who ate breakfast only at school, the contributions of iron and vitamin A for the entire day were significantly less than those who only ate at home. Students who ate only at home had lower breakfast contributions to their daily intake of saturated fat calories compared to those who ate at both at home and school.

Table 8: Percent Breakfast Intake Contributes to the Entire Day's Intake by Breakfast Location[1]									
Day Intake	% Breakfast Contributes to Day's Intake								
	Breakfast Location								
	Home			School			Both		
	Mean	±	SD	Mean	±	SD	Mean	±	SD
Energy and Macronutrients									
Calories	17.61	±	09.93[b]	19.35	±	6.83[b]	24.32	±	11.13[h,s]
Calories from Fat	14.50	±	12.61[s,b]	20.29	±	11.43[h]	21.07	±	12.65[h]
Calories from Saturated Fat	15.55	±	13.52[b]	20.12	±	10.87	21.68	±	13.94[h]
Protein (g)	15.04	±	10.17[s,b]	19.54	±	8.50[h]	22.48	±	14.36[h]
Micronutrients									
Calcium (mg)	23.00	±	15.60[b]	23.95	±	14.73[b]	32.26	±	17.19[h,s]
Iron (mg)	2.14	±	1.97[s]	1.29	±	0.74[h]	1.83	±	1.26
Vitamin A (RAE mcg)	32.03	±	23.99[s]	23.36	±	18.76[h]	31.35	±	20.17
Vitamin C (mg)	63.08	±	147.83	81.45	±	111.73	99.08	±	154.88
Fiber									
Fiber (g)	13.39	±	10.73	12.74	±	7.41	16.84	±	10.56

[1]Total n = 244, excludes those whose daily caloric intake was greater than or less than 2 standard deviations of the mean

h = different from "Home", s = different from "School" and b = different from "Both". The differences are statistically different at $\alpha = .05$

Discussion

Findings of dietary intake differences by breakfast location were detected among the test population of fourth graders. Although intake differences were noted, there were no significant differences among children's weight status in relation to dietary intake or where they ate breakfast. This suggests that location of breakfast consumption does not directly contribute to overweight. Other studies have examined children who skip breakfast and found that breakfast skippers are more likely to be overweight compared to breakfast eaters (15, 20). However, little research exists on weight differences and breakfast location among breakfast eaters. Even though this study found no relationship in weight and breakfast consumption and consumption location, there were various dietary intake differences associated with breakfast location.

Children in this study who ate breakfast at both home and school consumed significantly more calories at breakfast than those who only ate at home or at school. A previous study of the school breakfast environment at the schools participating in this study found the school breakfast environment provided 535 calories per person (21). However, children in this study who ate breakfast at school only consumed 384 calories, which is less than the SBP guidelines (554 calories) (22). Breakfast contributed between 18% and 24% of the entire day's calories (18% home, 20% school, 24% both). The SBP is designed to provide one-fourth of the day's caloric needs (22); however, only the children who ate breakfast at both home and school approached the SBP guideline.

Breakfast consumption only at school or at both home and school contributed more fat calories to the entire daily intake than eating only at home; however, breakfast only contributed to 15-21% of the entire day's fat calories (15% home, 20% school, 21% both). Even though the school breakfast (34% calories from fat and 13% calories from saturated fat) exceeded the SBP guidelines for fat and saturated fat (< 30% calories and < 10% calories, respectively) (22), the excess did not contribute to higher fat and saturated fat intakes over the entire day. Other studies have also reported that fat and saturated fat intakes were higher for SBP participants, and that the differences became negligible and insignificant over the course of an entire day (23-24). Graves (21) found that the school breakfast environment of the subject schools was higher in fat (43%) than the fat content reported for other schools (31%) (25-26). However, results from this study suggest that the children who ate breakfast only at school did not consume all of their breakfast. Partial consumption lead to the intake of 34% calories from fat in contrast to the 43% calories from fat available, if the entire meal had been consumed (21). However another potential explanation for this discrepancy is that the school breakfast environment was assessed on a per person basis and included adults, who could have skewed the results.

Children who ate breakfast only at school or at both home and school had significantly higher breakfast contributions of protein for the entire day compared to those who only ate at home. Children who only ate breakfast at school consumed 13 grams of protein and exceeded the SBP guidelines of 10 grams of protein. Gordon et al (24) also found that children who participated in the SBP consumed more protein over 24 hours compared to those who did not participate in SBP. Burghardt et al (26) reported that SBP participants were three times more likely to consume meat, poultry, fish or meat mixtures than those who did not participate, indicating that the SBP offered a higher fat and protein menu to children who ate breakfast at school compared to those who ate elsewhere.

Children in this study who ate breakfast only at school had lower breakfast intakes of iron and vitamin A than those that ate only at home or in both places. SBP participants did not recover from the vitamin A deficit and ended the day with a lower vitamin A intake. The children who ate only at school consumed almost 3 milligrams of iron (2.96 mg) and 144 retinol activity equivalent mcg, both are close to the SBP guidelines (3 .g and 197 retinol activity equivalent mcg, respectively) (22). The School Nutrition Dietary Assessment found no significant differences in vitamin A consumption in SBP participants and non-participants (24). The School Nutrition Dietary Assessment also found that SBP participants had higher average breakfast (7) and entire day calcium intakes compared to non-participants (4, 23-24). However, the current study only found that children who ate breakfast at both home and school had higher breakfast calcium intakes for breakfast and the entire day. No relationships were found for breakfast location and vitamin C intake. Similar results were found in the School Nutrition Dietary Assessment study (24), but a report on children's diets in the mid-1990's found that SBP participants were more likely to meet vitamin C requirements than non-participants (4).

One limitation of the present study was its relatively small size. The small sample size of 254 participants and 18 days of dietary and eating habit data could make it hard to detect subtle differences in weight status by dietary intake and breakfast location that could be revealed in a larger study. Several factors in addition to patterns of breakfast consumption are likely to contribute to weight status. For example, physical activity was not measured. Dwyer et al (15) reported that while overweight students consume more calories than normal weight students, the physical activity levels of overweight students are typically lower than that of normal weight students. Research also has shown that children with low socio-economic status tend to be heavier than their higher socio-economic peers (20). Therefore, socio-economic status may play a role in children's weight, but data to determine socio-economic status were not available for the current study.

Conclusion

Breakfast consumption was found to have no relationship to weight status among fourth graders evaluated during this study. Dietary intakes varied by breakfast consumption location and when expressed as percent breakfast contributes to the day's intake many of these differences persisted. Therefore, the SBP has a measurable impact on children's diets. Future research should examine dietary intake, breakfast location, and physical activity to better understand the relationships of to weight status. The influence of different socioeconomic status as measured by family variables and type of breakfast participation (free, reduced, or full price school breakfast) should also be considered.

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Appendix

Expanded Methodology

Introduction

This research assessed the school food environment, including energy, fat, saturated fat, and fiber and addressed the SBP and its contribution to children's energy, nutrient, and fiber intake and relationship to weight status. The subject group consisted of fourth grade children at five schools in a rural East Tennessee County. Specifically this research:

1. Described the overall school breakfast environment at five schools as a group, in terms of energy (kcal), total fat (g, % of energy), saturated fat (g, % of energy), and fiber (g), derived from foods purchased from the school breakfast choices offered (expressed on a per person per day basis).
2. Compared consumption of energy (kcal), total fat (% of energy), saturated fat (% of energy), protein (g), calcium (mg), iron (mg), vitamin A (RAE mcg), vitamin C (mg), and fiber (g) of children who ate breakfast at home, those who are breakfast at school, and those who ate breakfast at home and school.
3. Compared contribution of breakfast to the entire day's intake expressed as percent contribution for energy (kcal), total fat (% of energy), saturated fat (% of energy), protein (g), calcium (mg), iron (mg), vitamin A (RAE mcg), vitamin C (mg), and fiber (g) for children who eat breakfast at home, school, or both.
4. Compared consumption of energy (kcal), total fat (% of energy), saturated fat (% of energy), protein (g), calcium (mg), iron (mg), vitamin A (RAE mcg), vitamin C (mg), and fiber (g), of children who were not at risk for overweight ($< 85^{th}$ BMI percentile), those at risk for overweight ($\geq 85^{th}$ BMI percentile to $< 95^{th}$ BMI percentile), and those overweight ($\geq 95^{th}$ BMI percentile).

5. Compared children who ate breakfast at home, those who ate at school, and those who ate at home and school by weight status (not at risk of overweight, at risk of overweight, and overweight).
6. Analyzed if breakfast source (home, school, both) and nutrient status (energy, fat, saturated fat, calcium, iron, vitamin A, vitamin C, and fiber) increased the likelihood of students being at risk for or overweight.

Brief methodologies for each of the preceding research questions were presented in Part II and III of this thesis. The following is an in depth look at the methodology for completing this thesis. First is an overview of the Youth Can! study used, followed by a description of the methods used in the thesis

Research Design and Methods

Youth Can! As Source of Secondary Data Analysis

Data for this proposal were baseline results from a community trial called "Youth Can! improve their diets for a healthy heart" (Youth Can!). Youth Can! is a 2-year study of fourth and fifth graders in a rural East Tennessee County (Monroe County). There are two main goals of the Youth Can! study: 1) in year 1 collaborate with the fourth grade students and fifth grade teachers in selected schools to develop a fifth grade nutrition intervention (nutrition education and youth leadership) to reduce the prevalence of overweight and improve dietary behavior for the following year; and 2) in year 2 conduct a school-based trial of the impact of the nutrition intervention developed in year 1 on weight status of 5th grade students compared to nutrition education alone or weight monitoring alone. Baseline data in year 1 (height, weight, food survey, and a 24-hour dietary recall) were collected at five schools from fourth grade students. Youth Can! will track the students for 2 years to determine any impact on weight status of the students, and to evaluate the effect student leadership teams have on the school food environment. Only data from baseline were used in the current research.

All schools in the county school system with fourth and fifth grade classrooms (n = 5) are included in the Youth Can! study. The following table (table 9) displays the total number of students in fourth grade at the beginning of the Youth Can! study, the number that participated in the study, and the participation rate for each school. Each school also participates in the SBP and the NSLP. In Monroe County, TN, roughly 14% (14.2) of students receive a free or reduced priced breakfast. This rate is slightly lower than 16.6% of students across Tennessee who receive a free or reduced price breakfast (The State of the Child…, 2000).

Table 9: Fourth Grade Student Population, Youth Can! Participation, and Percent Participation at Each Study School

School	Total number of fourth grade students	Total number of fourth grade students participating in the study	Percent of fourth grade students participating in the study
1	10	10	100
2	24	19	79
3	76	57	75
4	151	118	78
5	89	52	58
Total for all schools	350	256	73

Youth Can! Subjects

Recruitment of students in year 1 occurred by sending a letter home with each fourth grade student in the Monroe County school system. The letter explained that the Youth Can! study would be assessing student nutrient intake and height and weight status and that a five-dollar Wal-mart gift card would be given to participating students. Before starting data collection, Human Subject Research approval was received from The University of Tennessee Institutional Review Board. Included in the initial letter sent home was an informed consent form that had to be signed by a parent/guardian and the student before any data were collected. Project staff checked each student's file to insure proper informed consent. A total of 350 students were invited to participate in the study with a response rate of 256 students (73%).

Youth Can! Measures

<u>Breakfast group</u>

Participating children were asked an open-ended question about the location of each eating occasion identified during the 24-hour dietary recall. Based on the response children gave for the question "Where did you eat this?" for any eating occasion that occurred between the time the child awoke and 45 minutes after school started, the children were classified into three groups. If the child's response to the question was "school," then the child was assigned to the SBP group. If the response was "home, in the car, or some place other than school," then the student assignment was the home breakfast group. If the child's response was "school and somewhere else," the child was assigned to the breakfast at school and home group. If the child did not consume anything from the time he/she awoke till 45 minutes after school started, then the child was assigned to a group of “no breakfast.”

Nutrient Intake for Breakfast and Total Day

To assess nutrient intakes, data from a 24-hour food recall collected for each child participating in the study were analyzed. Youth Can! followed the USDA automated multiple pass protocol (Conway, Ingwersen, Vinyard, et al., 2003) to collect diet recall. Prior to collecting data the project research staff were trained in the multiple pass protocol and use of the multiple pass method with the NDS-R system software version 4.06_34, developed by the Nutrition Coordinating Center, University of Minnesota. Training occurred at The University of Tennessee during a weekday morning prior to collecting data and in subsequent practice interviews. On data collection days, each participating student was given a unique identifier based on the school and the research staff person conducting the recall. During the first pass of the dietary recall interview, the interviewer asked the student to list all foods consumed and the time and location for each eating occasion. In the second pass the interviewer reviewed the list of foods and asked the student if he/she could remember eating/drinking any other items. On the last pass, the interviewer asked the student details about each food item, including how much was consumed, how the food was prepared, and what type of food it was (e.g. percent fat for milk). As students verbalized their responses, the interviewer entered the dietary data directly into the NDS-R software interview screen using a laptop computer (File names: McSch, MCS, MCTY, and yc).

Weight Status

As part of the Coordinated School Health Program in the Monroe County school system, every fourth grade student was weighed and height was measured in year 1 of the Youth Can! study. Students participated in the Coordinated School Health Program regardless of participation in Youth Can! Children were weighed three times on a calibrated digital scale, with each recorded weight rounded to the nearest 10^{th} of a kilogram. Using these data an average weight was calculated for each child based on the three recorded weights. The height for each child was measured using a stadiometer attached to a wall. Children were measured without shoes three times to the nearest centimeter; an average height was calculated based on these three records. Data were recorded for each child on a note card and then entered into an Excel Spreadsheet (BMI 2002-2003.exl). After completing the baseline data collection, research staff matched weight and height measures to the unique identifiers given Youth Can! participants during the dietary recall, creating a file of weights and heights of only Youth Can! participants (BMI 2003-2004 SHARE DATA.exl). Students who had not participated in Youth Can! were excluded from the study.

Methods for This Thesis

Child-Level Data

Nutrient Intake

Nutrient intake for each student was assessed as food energy (kcal), total and saturated fat (g, % of energy), and fiber (g). NDS-R nutrient analysis program was used to analyze nutrients for breakfast and the 24-hour intake for each child. Breakfast classification included any foods eaten from the time the child awoke until 45 minutes after school started. Data collection occurred on Tuesday, Wednesday, Thursday, or Friday to ensure that the students had an opportunity to eat at school. Students were asked to report on foods eaten the previous day. Data were not collected on Monday's because students would have eaten all foods from the previous day somewhere besides school and the intervention was focused on the school.

Weight Status

Each student's BMI was calculated from the weight and height measures using the CDC approved formula of weight (kg) divided by height (m) squared. Based on calculated BMI children were grouped into three groups: those at risk for overweight ($\geq 85^{th}$ to $<95^{th}$ BMI percentile), those overweight ($\geq 95^{th}$ percentile) and those not at risk for overweight ($<85^{th}$ BMI percentile). Student BMI data were calculated in SPSS and then grouped according to calculated BMI.

School-Level Data

Menu Documentation

This project completed secondary data analysis of Youth Can's! menu documentation as a measure of the school nutrition environment on a per person basis as calories, total fat, saturated fat, and fiber. Methods for the menu documentation were based on the Child and Adolescent Trial for Cardiovascular Health (CATCH) (Raizmen, Montgomery, and Osganian, 1994) and a study of school food service environments by Zive et al (2002), both previously discussed.

Youth Can! used similar menu documentation methods with a few differences. Youth Can! researchers collected menus and interviewed food service managers for each of the 18 days that 24-hour dietary recalls were collected. Once menus were collected, food service managers were interviewed for recipes and additional foods served, but not listed on the menu. Project research staff used production records provided by the schools to determine how much of each item was served, serving sizes, and how much was left over. One difference in the Youth Can! approach was that labels from the kitchens were not collected. However, food item bid sheets from the school vendors were available with detailed information on each food available for purchase. The bid sheets provided exact specification for the foods and many of the foods were already available in the NDS-R database. Food service staff were interviewed again to confirm ingredients used in mixed dishes and foods that were prepared on site. From the listed ingredients project research staff persons matched foods in the NDS-R that had similar composition. Once all the data were collected, project research staff entered the menus into NDS-R (MCMenu).

This research used the menu information collected at each school to determine the breakfast food service environment of the five schools as a whole. The researcher used the production records to determine the amount of each food item served at breakfast to describe the school food environment on a per person basis. Nutrient data from the menu documentation from NDS-R was exported to a SPSS data file and analyzed for energy (kcal), total and saturated fat (g, % of energy), and fiber (g). From the analysis, the researcher described the school food service breakfast environment on a per person basis.

SPSS was used to make the comparisons. Detailed steps for the CATCH/Zive et al study and the Youth Can! study is found in Table 10.

Table 10: Menu Documentation Protocol Comparison, Youth Can! and CATCH/Zive et al.

Youth Can! Menu Documentation Protocol	**CATCH/Zive et al Menu Documentation Protocol**
Breakfast and lunch menus collected for 14 days	Breakfast and lunch menus collected for 5 consecutive days
Food service managers interviewed to confirm menus and collect recipes if available	Food service employees interviewed for recipes
Production records and product bid sheets used to determine serving sizes and types of foods ordered; bid sheets provided exact specifications for foods (i.e. weights of foods)	Labels saved by all kitchens and collected by researchers
Items offered as self-serve were assigned standard serving sizes (i.e. French fries would equal ½ cup)	Items offered as self-serve were assigned standard serving sizes (i.e. French fries would equal ½ cup)
School meal participation forms used to assess number of breakfasts and lunches served	School meal participation forms used to assess number of breakfasts and lunches served
Project research staff compared school menus, manager interviews and production sheets to identify any missing foods	Nutritionist compared menu documentation forms, school menus, manager interviews and label to identify any missing foods
Food service managers interviewed again with further questions regarding food items and preparation methods	Cafeteria managers interviewed to provide more detailed information on food items
Kitchen staff contacted regarding information needed on food items prepared from multiple ingredients, recipes were obtained when available or staff was questioned on specific amounts of ingredients used in mixed or prepared dishes	Cooks interviewed at a follow-up visit to complete recipe forms for any item prepared from two or more ingredients.
	Missing vendor labels requested from district purchaser's record or food manufacturer

Analyses

Multiple analysis techniques were used to answer the research questions. NDS-R was used to analyze specific nutrient information from the foods consumed by the student and that comprised the school food service environment. Once nutrient information had been analyzed using NDS-R, SPSS was used to complete the remaining data analyses and comparisons. When examining energy, total fat, saturated fat, protein, calcium, iron, vitamin A, and vitamin C the USDA's guidelines for SBP were used. However, guidelines from the USDA do not exist for fiber; therefore the RDA was used.

To answer Question 1: Describe the overall school breakfast environment in terms of energy (kcal), total fat (g, % of energy), saturated fat (g, % of energy), and fiber (g) derived from foods purchased (expressed on a per person per day basis). This was accomplished using descriptive statistics, which included means of the foods purchased. Production sheets were used to assess how much of each food item was sold so that the school food environment could be described on a per person per day basis. Means of nutrients were assessed based on the amount of food served and the nutrient composition of the food.

Answering Question 2: Compare the consumption of diet intake variables (energy (kcal), total fat (% of energy), saturated fat (% of energy), protein (g), calcium (mg), iron (mg), vitamin A (RAE mcg), vitamin C (mg), and fiber (g)) of children who eat breakfast at home, those who eat breakfast at school, and those who eat breakfast at home and school. This was accomplished using means testing and analysis of variance (ANOVA). A mean for each variable being analyzed (energy, fat, etc.) was determined for each breakfast group (home, school, both). ANOVA was then utilized to determine if differences existed for the dietary variables by breakfast group.

Question 3: Compare contribution of breakfast to the entire day's intake expressed as percent contribution for energy (kcal), total fat (% of energy), saturated fat (% of energy), protein (g), calcium (mg), iron (mg), vitamin A (RAE mcg), vitamin C (mg), and fiber (g) for children who eat breakfast at home, school, or both. This was accomplished by means testing and ANOVA was once again used. ANOVA was used to determine if differences existed for each dietary variable expressed as percent contribution of breakfast by breakfast group. The approach was similar to what was done in comparing just breakfast. The researcher evaluated if one breakfast group had a significantly higher or lower energy, total fat, saturated fat, and fiber intake over the entire day's intake.

To answer Question 4: Compare consumption of energy (kcal), total fat (% of energy), saturated fat (% of energy), protein (g), calcium (mg), iron (mg), vitamin A (RAE mcg), vitamin C (mg), and fiber (g) of children who are not at risk for overweight ($< 85^{th}$ BMI percentile), those at risk for overweight ($\geq 85^{th}$ to $<95^{th}$ BMI percentile), and those overweight ($\geq 95^{th}$ percentile). This was accomplished using means testing and ANOVA. A mean for each variable being analyzed (energy, fat, etc.) was determined for each weight status group. ANOVA was then utilized to determine if differences existed for the dietary variables by weight status.

Question 5: Compare children who eat breakfast at home, those who eat at school, and those who eat breakfast at home and school, by weight status was evaluated using a Chi-Square test.

Finally Question 6: Did breakfast source (home, school, or both) and breakfast nutrient intake (energy, fat, saturated fat, protein, calcium, iron, vitamin A, vitamin C, and fiber) increase the likelihood of students being at risk for or overweight was not assessed because no differences were found in dietary intake by weight and breakfast location by weight.

Vita

Andrea Graves was born in Maryville, TN on February 15, 1981. She was raised in the same town and went to Rockford Elementary School and Porter Elementary School. She attended Heritage High School where she graduated in 1999. From there she went to Tennessee Technological University in Cookeville, TN where she received a Bachelor of Science in Human Ecology in 2003.

Andrea is currently pursuing a Master's of Science in Nutrition (Public Health Nutrition option) and Master's of Public Health (Community Health Education concentration) at the University of Tennessee, Knoxville.