O'CONNELL, KELLIE M., Ph.D. Impact of the *HEROS (Healthy Eating to Reduce Obesity through Schools) Study* on Healthy Food Choices and Obesity among Middle School Students in Guilford County (NC) Schools. (2005)
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The prevalence of overweight among adolescents in the U.S. has increased rapidly over the past two decades. This problem is closely related to poor dietary behaviors. Two preliminary, school-based studies were conducted in Guilford County Schools, which demonstrated that: 1) cafeteria environments do not foster healthy eating, and 2) a milk promotion program is a feasible intervention. These studies provided the rationale for the *HEROS (Healthy Eating to Reduce Obesity through Schools) Study*. The central hypotheses were that by increasing the availability of fruits, vegetables, and dairy products (FVD) and the awareness of the health benefits of choosing FVD: 1) intake would increase; and 2) the prevalence of obesity would decrease among middle school students.

Participants were 489 seventh grade students from six schools (e.g., paired for socioeconomic status and ethnicity). The schools were randomly assigned to control or intervention groups. Intervention components were implemented over 23 weeks. Intervention components included: 1) nutrition education through curriculum, school dinners, and mailing information to families and 2) changes to cafeteria environments to increase the availability and awareness of FVD. Outcome measures were taken pre- and post-intervention and included: 1) estimated FVD intake at school lunch using the O'Connell School Food Diary; 2) estimated overall daily FVD intake using the Youth and Adolescent Food Frequency Questionnaire; and 3) overweight and obesity

prevalence using body mass index and triceps skinfold thickness. Analysis of variance and Chi-square analyses were used to test for significant differences between groups at baseline. Change scores were calculated for pre- and post-intervention measures. A general linear model was used to test for intervention effects on these outcome variables. Significance was identified at $p \leq 0.05$.

The intervention group significantly increased their vegetable intake at school lunch by 1/5 of a serving (0.19 ± 0.14, $p < 0.04$), whereas the control group decreased their intake by 1/7 of a serving (-0.14 ± 0.07). African Americans in the intervention group significantly increased their daily vegetable intake by 1/3 of a serving (0.33 ± 0.25, $p < 0.001$), compared to their control counterparts who decreased their intake by 1/3 of a serving (-0.34 ± 0.22). No significant improvements were found for fruit or dairy product consumption or the prevalence of overweight or obesity. It was concluded that the *HEROS* intervention increased vegetable consumption both at school and throughout the entire day, indicating a promising school-based approach for improving the eating habits of adolescents, especially African Americans.

IMPACT OF THE *HEROS (HEALTHY EATING TO REDUCE OBESITY THROUGH SCHOOLS) STUDY* ON HEALTHY FOOD CHOICES AND OBESITY AMONG MIDDLE SCHOOL STUDENTS IN GUILFORD COUNTY (NC) SCHOOLS

by

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Approved by

_____
Committee Chair

My dissertation is dedicated to my parents, Dennis and Barbara O'Connell, who inspire me with their unconditional love for each other and for their family.

APPROVAL PAGE

This dissertation has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

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CHAPTER I

INTRODUCTION

Obesity among school-aged children is increasing at an alarming rate[1] and obese youth are more likely to become obese adults.[2] Obesity is now the second leading cause of death in the United States.[3] Increases in energy intake and/or decreases in energy expenditure result in weight gain that leads to obesity.[4] Previous studies have demonstrated that obesogenic diets of school-aged youth are high in sugar, fat and calories, and lack nutrient dense foods such as fruits, vegetables, and dairy products.[5-9] However, programs and policies to support societal increases in the consumption of healthy foods are lacking. To resolve the childhood obesity epidemic, feasible and effective nutrition programs and policies must be developed and implemented.

Schools have been identified as opportunistic environments to develop programs and policies that can lead to improvements in nutritional intake and subsequent decreases in obesity prevalence.[10, 11] Although several school-based approaches have been tested, study methods and outcomes on eating behaviors and/or obesity are not consistent,[12-18] making it difficult to decipher intervention components that are effective. The lack of substantial evidence identifying specific interventions that consistently lead to positive eating behavior changes is hindering the implementation of obesity-prevention programs in schools. Limitations of space, time, and financial resources for schools also hinder

implementation. Clarity of the critical factors that promote successful school-based nutrition interventions to prevent or reduce obesity will guide the way for program and policy changes.

Factors that influence the behaviors of school-aged children and adolescents are complex. These factors are both personal and environmental. At the personal level, adolescence is a particularly opportune time for nutrition interventions to create change. Adolescents are developing their identity, increasing autonomy and gaining independence.[19] Thus, it is a key stage to develop behavioral patterns since they are likely to be sustained into adulthood. Creating environments that foster healthy eating patterns allow adolescents to demonstrate healthy eating skills. Developing an approach to behavior changes based on an understanding of the complex interactions between the personal and environmental influences on adolescent eating behaviors provides the greatest likelihood that intervention goals will be met.

Health behavior models provide the framework to design an intervention, which leads to behavior changes. Health behavior models help to explain behavior by exploring how mediating personal and environmental factors are related to target behaviors, such as consuming healthy foods and being physically active. A combination of three behavior theories and concepts, the Social Cognitive Theory, an ecological model of behavior and social marketing, provides a conceptual model to develop the proposed school-based nutrition intervention.

The Social Cognitive Theory employs the concept of reciprocal determinism.[20, 21] In reciprocal determinism, several factors influence behavior. Changes to one or more of

the factors can influence the others. The factors of reciprocal determinism include characteristics of the individual, behaviors, and the environment(s) in which the behaviors are performed. Thus, the characteristics of the individual and the environment can be influenced or changed to impact a target behavior. Among school-aged youth, individual characteristics include nutrition knowledge and self-efficacy to choose healthy foods. The environment is the school, including both the classroom and the cafeteria. Following the Social Cognitive Theory, increasing nutrition knowledge and improving the self-efficacy of students to make healthy food choices within the school environment leads to increases in healthy food choice behaviors.[20]

The Social Cognitive Theory alone is not sufficient in providing a solid framework on which to develop a school-based nutrition intervention program.[12, 13, 21] Schools have an ethnically and economically diverse population of students. It is important to consider the differing ecological influences on the behaviors of individual students so that intervention components are designed to impact all students in the target population.[20, 21]

The ecological model of health behavior provides a more detailed explanation of the multilevel influences of individual and environmental interactions on healthy eating behaviors. Intrapersonal, interpersonal, and community levels are explored to design an intervention that can influence the individual at these multiple levels, which will lead to a greater impact than intervening at one level only. Thus, in school-based interventions, the ecological framework supports that the intervention should not only address healthy eating behaviors performed at school, but should also target behaviors at other levels,

such as at home or in the community. Additionally, an ecological approach to behavior change supports that interventions should be designed utilizing multiple organizational levels of society such as universities, coalitions, government agencies, and non-profit organizations, because these organizations influence the ecological environment.[20] Utilizing expertise and resources from multiple organizations that influence the individual's environment provides consistency of purpose for the intervention and a greater likelihood that behaviors of groups will be substantially impacted.

The Social Cognitive Theory combined with an ecological model of behavior provides an understanding of the personal and environmental influences on health behaviors. However, even these theories combined do not provide a guide as to how an intervention will capture the target audience and result in voluntary adoption of new behaviors. To fill this role, the concept of social marketing is employed.

Social marketing is a method of promoting target behavior changes by creating the desire for the target population to fulfill their own self-interests by adopting the target behaviors.[20] In doing so, the interests of both the target population and the organization promoting the behaviors are met. Social marketing often works by decreasing barriers to and increasing the attractiveness of the behavior. The characteristics of the target group are studied to create interventions that address their social desires. For example, it is important to consider the importance of appearance and popularity in the social nature of adolescents.[21] The marketing approach uses four elements: product, price, place, and promotion. Interventions addressing these four "Ps" decrease barriers to choosing healthy foods while increasing the appeal of healthy food choice behaviors.

Using the Social Cognitive Theory, an ecological model of behavior, and social marketing, an intervention was designed based on ecological influences (e.g., home, community, and society), the relationships between these environments, and interpersonal and intrapersonal dynamics of behaviors within these environments. Addressing self-interests of adolescents captured the attention of the target audience to promote the desired behavior changes. A nutrition intervention program designed from this combination of theories was hypothesized to increase the consumption of healthy foods (e.g., fruits, vegetables, and dairy products) by adolescents, which can contribute to decreases in obesity prevalence. Research is necessary to elucidate the role of school systems in solving the nutritional issues underlying the obesity epidemic, because there is limited knowledge of how the aforementioned mediating factors lead to behavior changes regarding food intake in school-based interventions.[21]

The purpose of the research described in the following chapters was to develop feasible, school-based approaches to increase the consumption of healthy foods, specifically fruits, vegetables, and dairy products, and to decrease obesity prevalence among adolescents. Two preliminary studies conducted in Guilford County Schools provided the basis for the primary study, *Healthy Eating to Reduce Obesity through Schools (HEROS)*. Food intake and obesity prevalence data from seventh grade students were analyzed to complete the following specific aims:

Specific aim #1. Determine the extent to which the *HEROS* intervention increases the consumption of fruits, vegetables, and dairy products by students.

Specific aim #2. Determine the extent to which the *HEROS* intervention reduces the prevalence of overweight and obese students.

The long-term goal of the *HEROS* intervention is to contribute additional insight to the literature, increasing the likelihood that nutrition interventions in schools will improve the health of students. This knowledge is expected to provide a starting point for the development of sustained programs and policies within Guilford County, North Carolina, allowing schools to actively improve the health of their students and support societal changes to reverse the trends in poor food choices and rising obesity prevalence among their students and their families.

CHAPTER II

REVIEW OF LITERATURE

Background

The health of our nation's youth is a prominent concern in the U.S. Like adult obesity, obesity among youth has become an epidemic. The National Health and Nutrition Examination Survey (NHANES) IV reported that 64% of adults are overweight (body mass index [BMI] $\geq$ 25 kg/m^2) and 30% are obese (BMI $\geq$ 30 kg/m^2).[1] Overweight (BMI-for-Age $\geq$ 95th percentile) among adolescents (12-19 years of age) has also increased to 15% in the U.S. Obesity in adolescence is strongly associated with obesity in adulthood and, thus, is linked to the morbidities and mortalities of adult obesity.[2]

Adult obesity is associated with coronary heart disease, congestive heart failure, numerous cancers, type II diabetes, stroke, arthritis, hyperlipidemia, hypertension, and sleep apnea.[2, 22] Obese adolescents are at risk for type II diabetes and asthma even before they reach adulthood.[23, 24] Greater than 300,000 Americans die each year from obesity-related complications.[25] Direct costs associated with obesity in the U.S. make up almost 10% of the national health care expenditure, amounting to $117 billion per year.[3] Decreasing the prevalence of obesity would decrease obesity-related costs for medical services and lost productivity, estimated at $52 and $4 billion a year, respectively.[26]

To prevent these obesity-related threats to our nation's health, the Healthy People 2010 agenda has been designed to "identify the most significant preventable threats to health and to establish national goals to reduce these threats". The Healthy People 2010 objective for overweight status is to decrease the percentage of youth who are obese to 5%.[27] The necessity to reach this goal is essential to improve the quality of life for Americans.

Reaching this goal is a difficult challenge. Research is crucial to determine novel strategies for preventing obesity, because treatment is ineffective.[28] Improving trends in food choices is an important key to decreasing obesity prevalence. It is likely that decreasing obesity by improving food intake trends will also decrease disease prevalence, because poor diets are linked to several of the morbidities associated with obesity (e.g., cardiovascular disease, cancer, diabetes).[29, 30] The following review of literature will outline the underlying nutrition-related factors that contribute to obesity among youth and support strategies for preventing obesity, the most important nutritional problem among Americans.

Increased energy intake and/or decreased energy expenditure result in weight gain that leads to obesity.[4] To support a healthy weight, diets must be nutrient-dense, but not exceed caloric needs. The nutrient density of foods consumed is a primary influence on nutrient and energy intakes.[31] Nutrient density is defined as the nutrient quality per 1000 calories of a food item or meal. The concept is that if the quantity of nutrients per 1000 calories is large enough, the nutrient needs of an individual will be met when their energy needs are met.[32] This concept is important in evaluating causes of and interventions for

preventing obesity among youth, because most foods associated with obesity are low in nutrient density, but high in energy density.[33]

Diets that contribute to obesity among school-aged children are excessive in fat, sugar, and total calories from foods that lack important nutrients.[5, 6] The nutrient-dense foods that are lacking include fruits, vegetables, and dairy products.[7-9]

Soft drink consumption is high among adolescents.[5, 6] Soft drinks provide energy from simple sugars, but do not provide the vitamin, minerals or fiber found in fruits, vegetables, and dairy products. Consuming soft drinks actually replaces nutrient-dense beverages such as milk or juice[5] and in doing so, supports a diet that is high in sugar and lacks nutrient-dense beverages.

Consuming foods that are high in nutrient density helps prevent obesity. For example, some nutrient-dense foods increase satiety. Satiety is the state in which an individual no longer has the desire to eat or feels satisfied.[34] Fruits and vegetables are excellent sources of vitamins, minerals, and other phytochemicals that have important health benefits. They are also excellent sources of fiber and water, which have been shown to increase satiety.[35] Not only do fiber and water increase satiety, but they also do so without providing digestible energy. In fact, fiber can decrease the absorption of fat and carbohydrates.[35] Thus, foods such as fruits and vegetables, which are good sources of fiber and water, are important components of a nutrient-dense diet.

Dairy products are also an important component of a nutrient-dense diet. Dairy products are the primary source of calcium in the diet, an important mineral for peak development of bone mass during youth.[36] Recently, it was shown that consumption of

calcium-rich foods is related to lower body fatness in youth and adults.[9, 37, 38] It has been hypothesized that calcium, as well as many other bioactive components of dairy products, have anti-obesity effects in the body.[39] Consumption of dairy products is inversely related to insulin resistance syndrome among overweight young adults.[40] Milk has also been proposed to contribute more to satiety compared to soft drinks.[5]

The substantial evidence supporting the health benefits from consuming a nutrient-dense diet, adequate in fruits, vegetables, and dairy products, is expressed in the Healthy People 2010 objectives for dietary intake.[27] The Healthy People 2010 objectives for youth include increasing the proportion of persons 2 years and older who: 1) consume at least two daily servings of fruit to 75%, 2) consume at least three daily servings of vegetables, with at least one being dark green or deep yellow to 50%, and 3) meet the dietary recommendations for calcium ($\geq$ 1300 mg/day) to 75%.[27] U.S. youth are not meeting these objectives. Neumark-Sztainer et al.[41] found that among adolescents (n = 4,746), only 46.4% of girls and 45.3% of boys consumed at least two servings of fruits per day. The percentage of girls and boys consuming at least three servings of vegetables per day were 17.5% and 15.5%, respectively. The percentage of girls and boys consuming 1300 mg/day of calcium were 30% and 43%, respectively. Other studies have found similar trends of low consumption of fruits, vegetables, and dairy products.[5, 8, 42-44]

There is ample room for improvement in the diets of youth and a strong likelihood that improvements will lead to decreases in obesity prevalence. Of the stages of youth, adolescence is a particularly opportune time for nutrition interventions to create change.[21] Adolescents are developing both physically and psychosocially. They are developing

their identity, increasing autonomy, and gaining independence during adolescence.[19, 45] Thus, it is a key stage to develop behavioral patterns since they are likely to be sustained into adulthood. However, novel public health campaigns to promote healthy eating behaviors are needed.

Influences on Eating Behaviors

Despite support for healthy eating, there is a lack of research among adolescents demonstrating that healthy diets decrease obesity.[12, 46] Successful initiatives are not easy to find because there are numerous eating behaviors that need to be targeted (e.g., decrease fat, sugar, and total calorie intake and increase consumption of nutrient-dense foods), and there is a myriad of influences on those behaviors.[4] Theories and concepts can map the complex mediators between the characteristics of the target group, their environment, and the target eating behaviors.

To explore the complex mediators of eating behaviors of adolescents, investigators must understand the intrapersonal, interpersonal, and environmental factors that impact the behavior. Specific mediators can be clustered and described as a behavior model to provide a theoretical framework to develop nutrition intervention programs. Prior research has used numerous theoretical frameworks.[47] Stages of Change,[48, 49] the PRECEDE-PROCEED model,[49, 50] and the Social Cognitive Theory[12, 51] have been used for nutrition interventions among adolescents.

The Stages of Change model consists of six dynamic stages of behavior: precontemplation, contemplation, preparation, action, maintenance, and termination[52]

Precontemplation is the stage an individual is in before they have considered making a behavior change. In contemplation the individual is aware a behavior change needs to be made and is seriously considering taking action to do so. In the preparation stage the individual has committed to taking action sometime within the next 30 days. During the action stage, measurable efforts are made to change the behavior. Maintenance is the stage when the behavior is stabilized and should last for at least 6 months. Termination, the final stage, occurs when there is no chance that the individual will relapse to the old behavior. This stage is not usually used in nutrition interventions.[52] Nutrition programs can identify the stages of change for adolescents.[48, 49] Understanding the influences of each stage on behavior help to clarify how behavior change is contemplated, which is useful in planning and assessing interventions.[48] However, the Stages of Change model does not address how interventions will provide resources or knowledge to support progression to action and maintenance.

The PRECEDE-PROCEED model describes three constructs that indicate what and how intervention components will promote behavior changes. These three constructs are predisposing, enabling, and reinforcing factors.[53] Predisposing factors provide the rationale for the individual to understand why he/she should perform the behavior. They include knowledge, attitudes, and beliefs such as self-efficacy. Self-efficacy is the confidence someone has that they can perform a behavior.[20] Enabling factors allow the individual to realize that they can perform the behavior and include skills and access to resources. Reinforcing factors occur after a behavior is performed and increase the likelihood that the individual will repeat the behavior. Reinforcing factors provide

rewards that contribute to persistence. Although this model mentions that adequate and appropriate resources are needed to promote behavior change, the PRECEDE-PROCEED model does not define the interaction between predisposing, enabling, and reinforcing factors and the environment.

The Stages of Change and the PRECEDE-PROCEED models have been successful models for planning interventions; however, the Social Cognitive Theory has been reported most often for nutrition interventions for adolescents,[47, 54] and is often coupled to other theories.[12, 13, 21] The Social Cognitive Theory describes behavior as a dynamic interaction between personal characteristics, environments, and the behaviors practiced in those environments.[20] These dynamic interactions are reciprocal determinants of behavior. That is, changes in one component affects the other two. Self-efficacy, behavioral capabilities, expectations, and reinforcement also influence behaviors. Behavioral capabilities can increase self-efficacy, because they provide the knowledge and skills needed to perform the target behavior. Expectations are beliefs regarding the outcome(s) of adopting a behavior. Behavior capabilities such as the knowledge of the health benefits and the taste of healthy foods can increase the student's self-efficacy to make healthy choices that meet their preferences. Knowledge can also create new expectations for the meaning of adopting the behavior such as choosing nutrient-dense foods to promote a healthy weight. A student may receive verbal, positive reinforcement for making a healthy choice by family or teachers, which increases the likelihood the student will repeat the behavior.

The Social Cognitive Theory provides a sound understanding of the cognitive determinants of behavior change in a given environment. However, the Social Cognitive Theory does not describe the many dimensions of an adolescent's life. Like the Social Cognitive Theory, the ecological approach uses the concept of reciprocal determinism. However, in an ecological model of health behavior the determinants of behavior encompass a broader environment, the ecological environment.

The ecological environment includes all levels of environments that influence behavior. These levels have been defined as microsystems (e.g., interpersonal interactions in family, school, and peer networks), mesosystems (e.g., the connections between the microsystems), exosystems (e.g., community and media influences), and macrosystems (e.g., culturally based belief systems and economic and political systems).[20, 21] The ecological approach indicates that within the microsystem level there are multiple interpersonal components that determine how the mesosytems interact. Interpersonal factors are particularly important during adolescence, because it is a time for social development.[21] Microsystem characteristics of families include their socioeconomic level, ethnicity, practices, and beliefs.

Story et al.[21] has proposed a combination of the Social Cognitive Theory with an ecological behavior model to explain the personal and environmental dynamics influencing behavior. To design a nutrition intervention for adolescents, the aforementioned models do not propose how the intervention is going to capture the attention of adolescents. Adolescents are targets of the food industry, because they influence how and where family income is spent and are often earning their own money

to spend.[21] Thus, the food industry finds means to get the attention of youth. Unfortunately, foods marketed to youth are predominately high in sugar, fat, and/or calories, contributing to poor diets and high obesity prevalence. Overcoming the influence of public advertising of unhealthy foods to youth is a challenge, because budgets for promoting fruits, vegetables, and dairy products are minute in comparison.[55]

Social marketing is a method of promoting target behavior changes by creating the desire to fulfill self-interests through adoption of the target behaviors.[20] In doing so, the interests of both the target population and the investigator are met. Social marketing often works by decreasing barriers to a behavior and increasing its attractiveness. To do this, the characteristics of the target group are studied. Then, interventions are created to address their desires.

The social marketing approach uses four elements: product, price, place, and promotion to elicit target behaviors.[20] Interventions addressing these four "Ps" decrease barriers while increasing the appeal of the behavior. Introducing a new product or bringing attention to an already established product can achieve this. Lower priced products are more accessible to adolescents. The placement of products within eating environments utilizes convenience to encourage choosing the product. Finally, the product can be promoted to adolescents to advertise how choosing the product will fulfill their self-interests for an attractive appearance and social acceptance.

School Impact on Eating Behaviors

For nutrition interventions to impact adolescents as a population, programs need opportunities to mold the knowledge, attitudes, and beliefs of adolescents regarding food choices. To do this, programs must have access to eating environments as well as opportunities to educate and interact with adolescents and their families. Schools provide these opportunities. Schools are particularly suited for nutrition interventions for adolescents; because they have access to 95% of the student population in the U.S.[56] and 35-40% of daily energy intake is consumed at school.[57] Schools function to educate students; thus, they are natural settings to increase nutrition knowledge. Families and communities naturally interact with schools. Through these interactions, school-based programs can address nutrition issues.

Schools are acknowledged for having a strong influence on the eating behaviors of students.[10, 11] The characteristics of the school environment must be understood to design theory-based nutrition programs. The primary influences on eating behaviors within the school environment are those related to food availability and nutrition education.

The first of these, food availability, influences the development of student eating behaviors, because a large proportion (35-40%) of the foods students consume is consumed at school.[57] Thus, the types of foods available and how students access these foods are important influences on what students eat.[58] A glossary of terms used when describing school eating environments is provided in Appendix A. There are a variety of foods available to students through different venues such as the National School Lunch

Program (NSLP) and School Breakfast Program (SBP), snack bars (also referred to as a la carte lines), vending machines, and school stores.[59]

The NSLP and SBP were created in the1940s to improve the status of undernourished youth, especially those from families of low-income, so that students would be better prepared to learn.[27] The programs were established under the NSL Act in 1946 with the objectives "to assist States, through cash grants and food donations, in making the school lunch program available to school children and to encourage the domestic consumption of nutritious agricultural commodities."[27] Under the NSLP, school-aged children can qualify for reduced or free meal prices. For a student to qualify for free lunch, their family income must be less than 130% of the poverty line. For a student to qualify for lunch at a reduced price of $0.40, their family income must be between 130% and 185% of the poverty line. Students who do not qualify pay $1.55 for their NSLP school lunch.[27]

NSLP school lunches must meet the Dietary Guidelines for Americans for percent calories from fat and saturated fat and must provide one-third of the Recommended Daily Allowances (RDA) for protein, vitamin A, vitamin C, iron, calcium, and calories.[60] These guidelines are for nutrients, but school lunches must meet these guidelines by serving foods. The types of foods that make up a school meal are variable; however, some standards do exist. Generally, a school lunch is made up of a combination of three to five components.[60] The components are a serving of milk, meat/meat alternative, bread/grain product, fruit/fruit juice, or vegetable. Components can be combined in an entrée. For example, a slice of pizza is an entrée, which provides two components, a meat/meat

alternative component (cheese and/or meat topping), and a bread/grain component (pizza crust). Components that are not entrees are referred to as "side items". Examples of side items include beverages such as milk or juice, fruit such as an apple or fruit cobbler, and vegetables, such as green beans or French fries. NSLP school lunches are sold from the school cafeteria food line. The food line is where hot and cold foods are served to students and is the primary intended locations for foods for students.

There is no doubt that implementation of the NSLP and SBP increase the nutrient intakes of participants.[61-65] However, the prevalent increase in obesity among school-aged children, especially among vulnerable populations eligible for free or reduced meal prices, has led researchers to investigate foods available in schools to determine factors that may contribute to poor eating behaviors.

The School Nutrition Dietary Assessment Study collected information about all meals served for one week in 1992 and information about food service policies and procedures from a nationally representative sample of schools.[66] From these schools, approximately 3,350 students (grades 1-12) provided 24-hour recalls for a school day. All age groups met the micronutrient daily recommendations except for adolescent (11 to 18 years old) females whose calcium and iron intakes were below recommendations.[62] All groups consumed more than the recommended amount of calories, protein, fat, and saturated fat. These intakes met the NSLP goals of a minimum of one-third of the RDA,[62] but because they also exceeded these recommendations, the excess calories and fat may promote obesity. Other researchers have found similar findings.[63, 65]

In addition to the NSLP meals, other foods are also available to students through school venues including the food line, snack bars (also referred to as "a la carte lines"), vending machines, and school stores.[59] Foods sold through these venues are sold outside of the NSLP and compete with NSLP school meals. Therefore, they are referred to as "competitive foods."[11] Competitive foods sold on the food line, on snack bars, and in school stores are often referred to as "a la carte" items. The other major venue for competitive foods is vending machines.

Unlike school lunches sold through the NSLP, competitive foods do not follow nutritional guidelines. Prior cross-sectional studies have investigated the prevalence and nutritional content of these foods to determine the impact they have on student food intake. The School Nutrition Dietary Assessment Study reported that more than 90% of schools provided a la carte foods at lunchtime and 55% of middle schools had vending machines selling foods for lunch.[62] This is a concern, because the majority of these foods are not nutrient-dense.[67] A survey of nationally representative schools indicated that 61% of middle schools sold cookies and cakes in vending machines, school stores, and snack bars that were high in fat and sugar, and 84% sold soft drinks, sports drinks, and other fruit drinks that were high in sugar. Only 12% of the middle schools sold nutrient-dense fruits and vegetables and only 19.5% sold low fat milk at these same locations.[11] Other studies have also found that competitive foods are high in fat and sugar and include few fruits, vegetable, and dairy products.[59, 67] A mean of 13 vending machines were found in the schools, with a range of 5-31. French et al.[67] stated that "the high availability of such foods conveys the message that these foods are acceptable 'anytime' foods and may

encourage students to choose these foods in preference to the school [lunch] program." Other researchers concur with this statement.[68-70] These studies support that competitive foods negatively impact the food choices of school-aged children and can contribute to obesity.

Like the foods available in schools, nutrition education also has the potential of being a primary influence on eating behaviors.[54] Nutrition education is defined as "any set of learning experiences designed to facilitate the voluntary adoption of eating and other nutrition-related behaviors conducive to health and well-being."[47] Positive attitudes about healthy eating and a better knowledge of the nutrient content of foods contribute to healthier food choices.[71] However, current nutrition education opportunities for students are not sufficient to support lifelong healthy eating behaviors,[72] especially in environments where nutrient-dense foods are not ample.

A survey by the National Center for Education Statistics (NCES) of a nationally representative sample of public schools found that nutrition education is integrated in some part of the curriculum in almost all middle schools, with just over half of schools integrating nutrition education into the total curriculum.[72] Some schools address nutrition topics in specific curriculum courses like health (85%), science (71%), and home economics (72%). However, only 66% of middle schools included nutrition education in a school health program. Research suggests that nutrition education efforts in schools coordinated by a person or group are better able to provide focused nutrition messages to students that emphasize the importance of healthy eating behaviors.[72] The lack of school health programs may limit the ability of schools to impact nutrition-related behaviors. In

the NCES survey, the majority of schools did not report a coordinated nutrition education program; meaning teachers were responsible for their own nutrition lessons. Thus, even though the survey indicated that nutrition education is a common component of school curriculums the authors emphasized, "the intensity and quality of the nutrition messages students are receiving is unknown."[72]

Nutrition topics covered by almost all schools were: 1) the relationship between diet and health, 2) finding and choosing healthy foods, 3) nutrients and their food sources, 4) the Food Guide Pyramid, and 5) the Dietary Guidelines for Americans. Although these topics appear to address knowledge, attitudes, and behaviors regarding choosing healthy foods, more than half of the schools covered only the Food Guide Pyramid thoroughly.[72]

Schools focus on increasing the knowledge of students regarding "good nutrition", but less importance is placed on influencing the motivation, attitudes, and eating behaviors of students.[72] Healthy eating patterns cannot be developed and maintained without the support of adequate nutrition education, that which not only leads to adequate knowledge, but also supports healthy behaviors.[47] The NCES survey provided an evaluation of nutrition education curriculum in public schools. When combined with the aforementioned characteristics of food availability in the school environment, a tangible basis emerges from which theory-based nutrition programs can be designed.

Dietary Assessment

Prior research has indicated the importance of designing and testing the effectiveness of school-based nutrition interventions.[21, 54, 73] Dietary intake must be measured to

understand the impact of the intervention on changes in food intake. This is a challenge because dietary assessment methods are often time consuming, expensive, require recalls of dietary intake, or are not specific to particular eating behaviors or dietary components.[74] The choice of method depends on the type of dietary information needed as well as the ease and cost of making assessments. The dietary assessment methods used in school-based research include food recalls, food records/diaries, food frequency questionnaires, and observations.[74]

24-h Recalls. Food recalls usually consist of a child (or parent) interview of the past 24 hours of dietary intake (24-h recall) conducted by a by a trained individual.[74] The 24-h recall estimates actual intake with specific details of brands, preparation methods, and servings sizes of foods consumed. This method can also assess where and when the foods were consumed. This information is valuable for assessing intake in specific environments such as schools. Several studies have validated the 24-h recall method to one day of diet records[75] and direct observations[76-78] with acceptable Pearsons correlations for calories (0.59-0.87) and macro- (0.5-0.91) and micronutrients (0.64-0.93). One 24-h recall per participant is sufficient to estimate intakes of groups. However, inter- and intrapersonal variation limits the use of a single recall to only estimates of the group. As many as ten days of 24-h recalls may be necessary to accurately estimate individual intakes.[79]

Although 24-h recalls provide detailed information, they are time consuming and, therefore, also expensive. Several school-based intervention studies have used 24-h recalls.[12, 13, 80, 81] Unlike cross-sectional and longitudinal studies, intervention studies

must gather participant data under time constraints. Many school-based intervention studies using 24-h recalls only assessed a subsample of participants.[12, 80, 81] Food recalls also rely on the individual's ability to remember what they ate.[74] Some validation studies indicate that recall may be better for foods eaten in specific environments such as schools, because the same foods are served repeatedly in standard serving sizes.[74]

Food Records/Diaries. Food records (or diaries) are written accounts of what was eaten over a specific time period.[74] Like 24-h recalls, detailed information is gathered including brand, portion size, and preparation method of foods consumed. Single day food records can estimate group intakes, but equations can be used to determine the number of days needed to estimate individual intake.[79] Unlike recalls, a benefit of food records is that they do not rely on memory.[74] For this reason, food records are often used to validate other methods. However, participants must be literate and records require substantial time from participants.[82] Underreporting is also common and analysis is costly.[82]

Food records have been validated using doubly labeled water,[83, 84] which is a gold standard for assessing energy expenditure.[85] However, doubly labeled water cannot assess macro- or micronutrients.[85] Food records have also been validated to observations.[75, 86] Validation studies have found mean food record intakes for energy that are 13-24% lower than doubly labeled water measures.[83, 84] Validations to observations have reported Pearson correlations 0.68-0.71 for energy, 0.63-0.82 for macronutrients, and 0.62-0.92 for micronutrients.[75, 86]

School-based intervention and cross-sectional studies have reported using food records/diaries.[87-89] One of the Gimme 5 interventions trained elementary school students

to use a record form on which participants recorded food intake while trained personnel assisted them in the classroom.[87-89] Seven days of record forms were completed. Written instructions, sample pages, and practice pages were provided. The diary form had lines with cues for meals and snacks, columns for food or drink and location, and check boxes for the number of servings (1/2, 1, 2, or 3).[87]

Students kept their records at school and were given take-home diary sheets for the weekend.[89] Daily and weekly monitoring of student food diaries was compared to observations of food intake at school lunch. The weekly approach involved two trained data collectors checking records for items and numbers of servings for 30 minutes per class per week. The daily approach used the same methods except records were checked daily and students were probed for forgotten items.[89]

A total of 117 observations and records were matched (50 for the weekly approach and 67 for the daily approach). Correlations ranged from -0.21 to 0.69 and were significant for three of nine meal items for the weekly approach. Correlations were improved for the daily approach ranging from 0.16 to 0.85 and were significant for eight of nine meal items for the daily approach. Underreporting was more common than over-reporting.[89]

Food Frequency Questionnaires. Food frequency questionnaires (FFQs) assess usual intake over a specified time period such as a week, month, or year and can be self-administered.[74] Individuals report the frequency of intake for specified items often with portion sizes provided. Several FFQs have been developed and validated for school-aged youth using 24-h recalls of dietary intake. FFQs do not provide detailed information

regarding where and when foods were consumed and often span long time periods rather than specific days.[74]

The Youth Risk Behavior Surveillance System Questionnaire (YRBSS) and the Behavioral Risk Surveillance System Questionnaire (BRSS) are two FFQs to assess fruit and vegetable intake on the previous day. The spearman correlation of fruit and vegetable intake (as one variable) from the YRBSS to 24-h intake was 0.28.[90] The spearman correlations of fruit and vegetable intake (as two variables) from the BRSS to 24-h intake were 0.30 and 0.43, respectively.[90]

The Youth/Adolescent Food Frequency Questionnaire (YAQ) uses 131 questions to assess the complete diet. The YAQ has been validated for use in populations of ethnically and socioeconomic diversity.[91, 92] The YAQ has been shown to be reliable with Pearson correlations from 0.26-0.58 for varying nutrients.[91] It has been validated to three 24-hour recalls of dietary intake with an r of 0.54.[92] Comparing energy intakes to total energy expenditure measured by doubly labeled water indicated that the YAQ provides an accurate estimation of mean energy intakes of groups but not for individuals.[93]

Observations. Observations of food intake are used for children that are very young (e.g., under eight years old) or when eating is in a controlled setting such as schools.[74] Well-trained observers watch participants eating and record what is consumed. One observation is considered actual intake and is; therefore, often used to validate other tools.[74] Single observations can estimate group intakes and several observations can estimate the usual intakes of individuals.[74] Inter-observer agreement has been the only

reliability test for observations. Inter-observer reliability has been estimated to be about 84% in a previous study.[94]

Despite the importance of and the multiple methods used to measure dietary intake among school-aged children, there is still ample need for better tools.[74] There is an increasing prevalence of nutrition intervention studies targeting foods in the eating environment in schools. Methods are needed that are easy and affordable to administer in the school setting. Of the currently available methods, 24-h recalls and direct observations are costly and too time consuming to complete in large groups in a short time period. FFQs measures overall usual intake. This is inadequate for interventions that target foods eaten at school, because the impact of the intervention may not be detected when measurements include foods eaten away from school as well. Food records/diaries have been successful in assessing intake in school-based intervention studies; however, the methods that have been used were time consuming and designed for elementary school children, not adolescents.

School-based Research

Several research groups have developed and tested nutrition interventions for school-aged children.[12-18, 49, 50, 87, 95] However, the majority of intervention studies have been conducted in elementary schools,[15-18, 95] have not been school-based,[13, 87] or have not addressed the consumption of fruits, vegetables, or dairy products.[18] More than a dozen fruit and vegetable interventions have been completed through the National Cancer Institute initiative, the national 5 A Day for Better Health Program, which was initiated in

1991.[96, 97] Two of these studies, Teens Eating for Energy and Nutrition at School (TEENS)[51] and Gimme 5: A Fresh Nutrition Concept for Students (Gimme 5),[49] were school-based with adolescent participants. A third school-based intervention, Planet Health,[12] also targeted fruit and vegetable consumption among adolescents. Planet Health was not part of the National Cancer Institute initiative and had several specific aims in addition to increasing fruit and vegetable consumption to contribute to decreases in obesity prevalence.

Contrary to fruit and vegetable interventions, school-based dairy interventions are not well documented. Previous interventions have primarily aimed to increase calcium consumption.[98, 99] The most abundant sources of calcium in the diet are dairy products.[36] Three dairy interventions were found; however, one of them was not school-based[100] and one was not published in a peer-reviewed journal. Only one school-based study was found that could be valuable for designing future programs, the Clueless in the Mall intervention.[50]

Of theses four school-based studies (e.g., TEENS,[51] Gimme 5,[49] Planet Health,[12] and Clueless in the Mall[50]) two types of evaluation procedures surfaced: 1) process evaluation and 2) outcome evaluation. Process evaluation is used to assess the quality of an intervention and the degree of participation by the target population.[21] Outcome measures are direct measures of mediators of behavior change (e.g., changes in knowledge, attitudes, and behaviors), the behavior itself (e.g., food intake), or outcomes of the behavior (e.g., decreased body fatness).[12, 49-51] The designs of prior interventions and the use of process and outcome evaluations to measure the impact of interventions provide

support for the development of future school-based programs promoting fruit, vegetable, and dairy product consumption among adolescents.

TEENS Study. The TEENS Study was a group-randomized trial designed based on the Social Cognitive Theory.[51] TEENS was conducted in 16 middle schools (8 intervention, 8 control). Multi-component interventions were implemented over two years to increase fruit, vegetable, and low-fat food consumption among seventh graders followed through eighth grade (n = 3,503). Four incremental exposures to interventions were used: 1) control, 2) school environment, 3) classroom and environment, or 4) peer leaders plus classroom and environment interventions. Environmental interventions included increasing the availability of appealing fruits, vegetables, and low-fat snacks in a la carte areas and vending machines. Posters were displayed promoting fruits and vegetables and indicating the fat and sugar amounts in snack foods. Taste-testing activities were also completed. The classroom interventions included ten class sessions. The authors did not indicate the length of each class session. Student families received three packages by mail with nutrition information and activities to complete with their child. Individual food intake assessment and goal-setting was also completed through classes. The peer leader intervention utilized trained peers to assist the teachers in these activities in addition to the classroom and environment intervention components.

Fruit and vegetable consumption was measured using a modified version of the Behavioral Risk Factor Surveillance System (BRFSS). Vegetable consumption excluded French fries. Low-fat food consumption was measured using a modified scale that presented students with pairs of food choices and asked them to identify the choices they

made most of the time. The original tool was previously tested with adolescents.[101] Pilot testing of the modified version of this tool resulted in a test-retest spearmen correlation of 0.65.

Process evaluation measures for the TEENS Study included assessing participation, dose, and quality of delivery of the intervention for the curriculum component of the intervention.[21] Attendance logs documented participants who were trained as peers. The peer leaders also completed an attitudes and behaviors survey at the conclusion of the program. This survey included 16 questions answered on a sliding scale. The delivery of the classroom intervention was assessed by observations completed by program staff using a 24-item tool. Teachers also reported the degree to which they implemented the TEENS curriculum. Finally, after the program ended classroom teachers were interviewed to assess their perceptions of the effectiveness of the program.[21]

The process evaluation indicated that 90% of peer leaders enjoyed being peer leaders and thought they did a good job. The majority of peer leaders thought that their friends thought the job was cool (63%) and would recommend the position to other peers (77%). Almost 65% reported that they ate healthier because they were a peer leader, and 85% said they had learned more about healthy eating. Non-peer leader participants (58%) reported that the peer leaders were helpful. Almost all teachers (93%) reported that the peer leaders were either “useful” or “very useful.”

As a result of the intervention, peer leaders increased their fruit consumption by almost a half of a serving per day. Students exposed to classroom plus environment interventions that were not peer leaders increased their fruit intake by almost a quarter

serving per day. Students exposed to only the environmental intervention increased their fruit intake by almost a fifth of a serving per day. No significant increases were found for vegetable consumption; however, the authors noted trends toward significance for the peer leaders and students exposed to classroom plus environmental interventions (but were not peer leaders). Increases in the consumption of low-fat foods were observed for peer leaders and students exposed to the classroom plus environment interventions as well. Students exposed to only the environment intervention did not increase their consumption of low-fat foods. No significant changes were observed for control students for fruit, vegetable, or low-fat food consumption.

The authors concluded that there was a dose response to interventions, with peer leaders benefiting the most from the interventions. The authors also noted the small impact of the environmental interventions was unexpected and may have been due to unequal exposure to these interventions. Environmental interventions focused on a la carte and vending foods in the TEENS Study. Student eating patterns differ and, because all students may not equally access these foods, the intervention may not have had a strong impact on all students. However, the eating patterns of students were not assessed; therefore, the contribution of eating patterns to intervention effectiveness could not be determined.

Planet Health. Planet Health was a group-randomized trial designed based on the Social Cognitive Theory and the behavior choice theory.[12] Planet Health was conducted in 10 middle schools (5 intervention and 5 control) among sixth graders followed through seventh grade (n = 1295 students). Interdisciplinary educational interventions were

implemented over two years to: 1) increase fruit and vegetable consumption, 2) decrease high-fat food consumption, 3) decrease television viewing time, and 4) increase moderate to vigorous activity. These behavior changes were planned to decrease obesity prevalence, the primary end point measurement. The Planet Health educational objectives were integrated into the framework of the state curriculum competencies. Each of the four educational objectives was integrated into four subject areas (e.g., science, language arts, math, and social studies) once per year for a total of 32 lessons over two school years. Lessons lasted approximately 45 minutes. The lessons also included a two-week goal-oriented activity, "Power Down," to decrease time spent watching television.

Obesity was measured by BMI and triceps skin fold thickness (TSF), with obese individuals defined as having BMI and TSF-for-age values at or above the 85th percentile on gender and age appropriate growth charts. Television and video viewing time (in hours) was measured using an eleven-item questionnaire with modest correlation ($r = 0.54$) to two 24-hour recalls of physical activity.[12] Moderate and vigorous physical activity (over the past month) was measured using the 16-item Youth Activity Questionnaire. This questionnaire was modified from a version intended for adults that demonstrated high reproducibility and validity in adults.[102] The Youth Activity Questionnaire demonstrated a good correlation ($r = 0.80$) of moderate and vigorous activity to the 24-hour recalls of physical activity. Fruit and vegetable intake, percentage of energy from fat and saturated fat, and total energy intake were measured using the YAQ. Consumption of French fries was not included for analysis of vegetable intake.

Observations were considered implausible and, therefore, excluded if energy intake estimates were less than 2,100 kilojoules or greater than 29,000 kilojoules.[12]

Teacher reports of intervention implementation were the only means of process evaluation for the Planet Health intervention. The authors indicated that this method has been shown to have good validity compared to classroom observations. This evaluation indicated that an average of 3.5 of 4.0 sessions were completed by curriculum course per year. Schools with greater experience with interdisciplinary curricula were able to implement the Planet Health intervention with greater ease than those with little experience with interdisciplinary curricula.

As a result of the Planet Health intervention, obesity prevalence among females in the intervention group decreased significantly ($p < 0.05$) from 23.6% to 20.3% compared to females in the control group. Obesity among males decreased in both the intervention and control groups. Television viewing decreased among intervention females and males by 0.58 (95% CI -0.8 to -0.31) and 0.40 (95% CI –0.56 to -0.24) hours per day, respectively. Female intervention participants increased their fruit and vegetable consumption (measured together) by three fifths of a serving and showed less of an increase in estimated energy expenditure (-575 Joules; 95% CI –1155 to 0 Joules/day) over the two years compared to control females. Changes in other outcome variables were not significant.

The authors suggested that the impact of the intervention on decreasing television viewing time was the primary contributor to decreases in obesity prevalence, because this variable predicted changes in obesity. However, increasing fruit and vegetable

consumption and attenuating increases in total energy intake may have also contributed to the decrease in obesity prevalence among females in the intervention group. The authors noted that different causal factors might operate among males and females, leading to differentiating impacts of interventions on obesity prevalence. The authors suggested that females might be more responsive than males to diet and activity interventions.

Gimme 5. Gimme 5 was a four-year intervention based on the PRECEDE-PROCEED model to increase fruit and vegetable consumption to five or more servings per day among adolescent students (n = 2,213, 14-15 years old) followed from their freshman to senior year at 12 high schools (6 intervention-control pairs).[49] Gimme 5 had three specific aims: 1) increase the awareness and positive attitudes concerning intakes of five or more fruits and vegetables a day, 2) develop and evaluate environmental supports for increasing the availability of fruits and vegetables at school, and 3) evaluate the impact of increased fruit and vegetable consumption on nutrient intakes of students.

The PRECEDE-PROCEED model addressed six levels of behavior change: awareness development, interest stimulation, skills training, reinforcement, application, and maintenance. To impact knowledge, attitudes, and behaviors, a multi-component intervention was designed. The four components of the intervention were: 1) a school media marketing campaign, 2) student workshops, 3) school food changes, and 4) parental involvement. The school media marketing campaign utilized a large cafeteria display with monthly promotions (e.g., produce giveaways) and displays of students' pictures and artwork. The displays incorporated nutrition messages explaining the benefits of the nutrients in fruits and vegetables designed to "key into student interests

and concerns." The media campaign also utilized table tents, point-of-service signs, posters, public service announcements, faculty fruit and vegetable baskets, faculty tip sheets and student contests. The second intervention component entailed five 55-minute workshops designed for students. The workshops used a variety of teaching approaches and addressed issues that were important to the students. For example, in one workshop students assessed their own eating habits and designed marketing strategies to promote healthy eating to their peers. The authors did not mention if the workshops were completed through a curriculum course or after school. The third component was called "Fresh Choices" and aimed to increase the availability, variety, and taste of fruits and vegetables in school meals. Guidelines for "Fresh Choices" were created to assist the cafeteria staff. New menus were created; needed items were purchased; and the new recipes were prepared and promoted in the cafeterias. The menus included twenty-one ethnic fruit and vegetable recipes. The fourth component was "Raisin Teens," which sought to increase parental involvement and support for the Gimme 5 program at home to increase positive attitudes among intervention students. Parents were encouraged to increase the availability and variety of fruits and vegetables at home. Brochures were mailed to family homes, including a monthly newsletter ("Gimme 5 Alive"), which requested nutrition-related questions and addressed them in subsequent newsletters. Taste-testings of Gimme 5 recipes were also completed at Parent Teacher Association meetings. These activities were promoted using calendars sent home with students.

Outcome measures included changes in knowledge scores, self-efficacy to choose fruits and vegetables, and intake of fruits and vegetables (measures together) measured

using the Knowledge, Attitudes, and Practices questionnaire.[97] This questionnaire included 22 questions assessing fruit and vegetable knowledge. Five questions assessed self-efficacy to choose fruits and vegetables on a five-point scale from extremely confident to not confident. Lower scores indicated higher confidence. Fruit and vegetable intake was measured by student self-reports of the number of servings usually consumed daily. The authors did not indicate the reliability or validity of these outcome measures.

Process evaluations included student ratings of the media marketing campaigns completed each semester. These measures were used as indicators of student awareness and acceptability of the campaign. Significant ($p < 0.05$) increases in awareness were found at the end of the program for the marketing stations, contests, and posters. Acceptability of the program was high after the first semester (67.2% to 96.6% rated components with a "thumbs up") and acceptability significantly increased for every component over the course of the program.

As a result of the Gimme 5 intervention, the percentage of correct knowledge scores significantly ($p < 0.05$) increased among intervention participants from baseline (38%) to follow-up (55%) and compared to control participants (45%). Self-efficacy increased for both intervention and control participant from baseline to follow-up. The authors noted the increase in self-efficacy for both groups might have been a reflection of the maturation process. Intervention participants also significantly increased their intake of fruits and vegetables (measured together) by one-third of a serving compared to control participants from baseline to an interim measure during year two of the study. This increase was less than the goal of three-fourths of a serving. At follow-up fruit and

vegetable consumption remained stable in the intervention group; however, increases in the control group over the last two years of the intervention resulted in no significant treatment effect at follow-up in year four. The authors noted that increases in the control group may have been a result of the national "5 A Day" campaign.[97]

Clueless in the Mall. In contrast to the three previously discussed school-based nutrition interventions targeting fruit and vegetable consumption, Clueless in the Mall was a nutrition intervention targeting calcium intake.[50] The primary source of calcium in the diet is from dairy products.[36] Clueless in the Mall utilized a web-based tool (accessible at http://calcium.tamu.edu) designed on the principles of the PRECEDE-PROCEED model to increase awareness, improve attitudes, and increase knowledge about calcium intake among adolescents (11-15 years old).[50] The website was intended to assist other educational efforts to increase calcium intake among adolescents. The predisposing, reinforcing, and enabling factors of the PRECEDE-PROCEED model were used in the website, plus other components that should be used with the website (e.g., taste-testing high-calcium foods, environmental changes, concurrent health messages to promote optimal health).[50] Predisposing factors included knowledge and attitudes about calcium's role in health and foods that were low in fat and high in calcium (e.g., primarily low-fat dairy) and self-efficacy about choosing foods that are excellent sources of calcium. Enabling factors included skills in reading food labels and access to resources such as recipes. Reinforcing factors included identification of appealing high-calcium products and encouragement from peers, teachers, parents, and physicians. These components combined were suggested to lead to increases in calcium intake and improved health.[50]

The Clueless in the Mall website used a scavenger hunt design where users self-discovered facts about calcium and health. Features were designed to appeal to youth by including animation, audio, video, and music clips. These clips included peer and adult role models discussing the importance of calcium in a healthy diet. A teachers' guide was developed to assist school-based implementation of the web site. This guide included classroom discussion and taste-testing activities.

Process evaluation for the Clueless in the Mall web intervention described the process of developing the web tool. A child development specialist reviewed a "storyboard" version of the web site to ensure it would be developmentally appropriate for adolescents. This version was pre-tested with eighteen middle and high school students. Individual interviews were completed with this subsample to assess for comprehension, clarity, and appeal of the designed website. The web version was then tested with a second subsample of nineteen students. Pre- and post-tests assessed the level of student concern regarding calcium on a scale of one to ten (ten being most concerned). Test scores increased from 4.68 before viewing the website to 8.26 after viewing the website.

The primary outcome measures assessing the impact of the website included measurements of knowledge and attitudes. A questionnaire was administered to 148 high school students during class in a computer lab. The authors did not mention the development or validity of the knowledge and attitudes questionnaire used. The following day students engaged in the website for 50 minutes. The best possible score for the questionnaire was 40. On the third day the questionnaire was repeated. Students

significantly ($p < 0.05$) increased their knowledge and positive attitudes regarding calcium, with pre-test to post-test scores increasing from 18.9 to 26.1. Changes in calcium intake were not measured, because the time frame used for analysis (three consecutive school days) was not long enough to include the non-web site components of their model (e.g., taste-testing high-calcium foods, environmental changes, and concurrent health messages to promote optimal health) or for the website to impact changes in food intake.[50] However, the authors noted that the process evaluation approach for developing and evaluating the website was crucial to its development. More than 190,000 "hits" on the website were documented over nine months, indicating the impact this innovative education approach has to reach a large audience. The authors also noted that school-based dietetics professionals should utilize the Clueless in the Mall website to show the connection between school meals and dietary recommendations.[50]

Discussion of School-based Studies

Of these four school-based studies, three sought to increase fruit and vegetable intake[12, 49, 51] and one to increase calcium consumption[50] to improve the diet quality of adolescents. Planet Health also aimed to decrease obesity prevalence. Though the specific aims of each study varied, several commonalities in intervention approach and evaluation exist. These similarities were considered for planning the proposed study, because these interventions were successful.

For example, the Social Cognitive Theory[12, 51] and the PROCEED-PRECEED model[49, 50] were health behavior theories used to design the interventions in these four

studies. Common themes of these two health behavior models include the impact of environmental, intrapersonal, and interpersonal characteristics on food choice behaviors.[12, 49-51]

Environmental characteristics included food availability and media marketing, which were components of the TEENS[51] and Gimme 5[49] interventions and were mentioned in the Clueless in the Mall conceptual model, but not included as a tested component.[50] Intrapersonal factors such as knowledge, attitudes, and behaviors were addressed through educational interventions delivered through school curriculum/courses in all four studies,[12, 49-51] although only two measured these mediators of behavior change.[49, 50] Of the curriculum approaches, two[12, 51] included student self-assessment and goal setting activities, which are emphasized in the literature to effectively promote behavior changes.[58] Taste-testings (demonstrating the target behavior) were also common behavior change activities. The interests of adolescents were identified as important intrapersonal factors by the Gimme 5 and Clueless in the Mall programs, and were addressed in the interventions by creating product appeal and developing connections between eating behaviors and attractive appearance. Finally, interpersonal characteristics were addressed through family dinners at schools and educational materials sent to students' homes in the TEENS and Gimme 5 interventions. The uses of health behavior models that describe the relationships between environmental, intrapersonal, and interpersonal influences on eating behaviors were crucial in developing these effective intervention components.

Program effectiveness was evaluated using program evaluations in all four of the interventions. However, evaluation approach differed by study. In the TEENS Study the fidelity of the curriculum intervention was measured using teacher reports and direct observations. The perceptions of participants and teachers were assessed. Planet Health used teacher reports of intervention implementation as well. The Gimme 5 interventions used student ratings of the media marketing campaigns as indicators of student awareness and acceptability of the campaign. Clueless in the Mall described the process of developing the web tool, including assessing its developmental appropriateness for adolescents and pre-test interviews for comprehension, clarity, and appeal of the design. Authors noted that process measures were crucial components of intervention development and evaluation.[50, 80]

Outcome evaluations also differed among these studies. Three studies measured dietary intake;[12, 49, 51] two measured knowledge;[49, 50] and one measured activity and obesity prevalence.[12] It is well documented that measuring dietary intake is difficult.[103] However, changes in dietary intake are important measures for determining the impact of an intervention. Of these four studies, no two studies used the same tool for evaluating dietary intake. This makes comparing the results of the studies difficult. In the studies that measured food intake, questionnaires were used.[12, 49, 51] Questionnaires can be administered easily in school settings, because they can be self-administered.[92] A questionnaire was also used in Planet Health to measure activity. Questionnaires acquire estimation data by requiring participants to remember behaviors and answer questions about those behaviors. The questionnaires used in these studies were tested for reliability

and validity. This is essential, especially for the studies that used modified versions of previously validated questionnaires. One of the questionnaires used, the YAQ, has been reported often in dietary assessment.[12, 93, 104-106] The YAQ is an appealing tool for several reasons. It has been validated in diverse groups of children and adolescents.[91-92] It is also printed and analyzed by the laboratory that designed it, which is convenient and time effective for research groups. The YAQ also provides data on a vast number of nutrients and food groups, making it useful for a variety of dietary intake measures.

The outcomes reported from dietary intake measures differed slightly. First, dietary intake of fruits and vegetables was consistently reported as one measure; however, the TEENS Study also reported fruit and vegetable intake separately. Although the benefits of increasing fruits and vegetables in the diet are similar (e.g., higher fiber, lower fat, increased nutrient intake and decreased caloric intake), patterns of intake and the impact of intervention components may not be the same for fruits compared to vegetables. The TEENS Study found significant increases in fruit and vegetable consumption when intake was analyzed together; however, separately significance was found for fruit intake but not for vegetables, proposing that the intervention impacted fruit intake more than vegetable intake. In the other two studies that measured fruit and vegetable intake together it is uncertain if interventions affected the intake of one group more than the other. Authors did not note why intake was reported combined. Specific aims used the "5 A Day" message as a target, which addresses fruit and vegetable intake together. Thus, intake was likely combined to reflect the specific aim of increasing fruit and vegetable intake to five or more servings per day.

Fruit and vegetable intake was successfully increased by all three studies seeking to do so. However, Planet Health only observed increases for females, and the TEENS Study did not find increases in vegetable consumption when fruit and vegetable intake was analyzed as two measures. As a result of interventions lasting two to four years, fruit and vegetable consumption was increased by 0.32 to 1.00 serving per day. In Planet Health, obesity prevalence among females was also decreased. Although females increased their fruit and vegetable intake, authors attributed the decrease in obesity prevalence to decreases in time spent watching television, also a target behavior of the Planet Health intervention. Because the other studies did not measure obesity prevalence, the impact of increased fruit and vegetable intake on obesity is unknown.

Clueless in the mall was the only school-based intervention study found that sought to increase dairy/calcium consumption among adolescents. This is a problem, because adequate dairy intake is an important component of a nutrient-dense diet.[36] The lack of interventions targeting dairy intake may be because a negative relationship between dairy intake and cancer risk is not well documented[107] as it is for fruits and vegetables.[108] However, there is a negative correlation between dairy intake and obesity,[5] which is linked to cancer.[22] The correlation between food intake and disease risk is important in developing funding programs to target the intake of specific groups of foods, such as fruits, vegetables, and dairy products. The link between calcium intake during adolescent years and the risk for developing osteoporosis later in life is well documented.[36] However, this link has not provided adequate motivation to lead to intervention programs as widespread as “5 A Day.” The “got milk” campaign is a well-known media marketing

campaign targeting milk.[109] Even though this campaign is promoting a healthy beverage, it is implemented by industry to market a product, not to promote public health. This campaign and others like it could be important components of school-based interventions if utilized by nutrition professionals in a public health campaign the way that the "5 A Day" program was used in the studies discussed here.

The development, implementation and outcomes of the discussed studies provide important puzzle pieces to contribute to the concept of the proposed study. The strengths and weaknesses of these programs as well as the need for interventions to increase dairy product consumption provide the basis to develop a new school-based program. By reporting the development, implementation, and outcomes of the proposed research, it is hoped that contributions to the literature will be made that will contribute to the forward movement of school-based nutrition programs to increase fruit, vegetable, and dairy product consumption and decrease obesity prevalence among adolescents.

CHAPTER III

CONCEPTUAL MODEL

A conceptual model was designed to guide the development of the proposed research. This conceptual model (Figure 3.1) is based on components of the Social Cognitive Theory,[20] an ecological behavior model,[20,21] and social marketing.[20] Using this combination, an intervention can be designed based on ecological influences (e.g., home, community, society), the relationships between these environments, and interpersonal and intrapersonal dynamics of behaviors within these environments. Addressing the self-interests of adolescents through social marketing can capture the attention of the target audience to promote the desired behavior changes.

In the conceptual model, eating behaviors of adolescents are the target behavior. Three categories of factors influence the eating behaviors of adolescents: environmental, interpersonal, and intrapersonal factors. Within each category there are several mediators that influence the target behavior either directly or indirectly through other mediators. Arrows are used in Figure 3.1 to depict these directions of influence. Within each of the three categories specific influences were identified as targets for the proposed research. These specific influences are listed in the appropriate categorical boxes in Figure 3.1.

Environmental characteristics that were targets for the proposed research include homes and schools. Within homes, the foods that are available are a target. Within

schools, the food service system(s) and media marketing are targets. These factors impact the eating behaviors of adolescents indirectly by influencing interpersonal and intrapersonal factors.

Interpersonal characteristics are those related to the individuals within an environment who interact with the target group. For the proposed research, families and school staff were identified as influences on eating behaviors. The food-related practices and beliefs and socioeconomic status of family members and the educational goals and modeling behaviors of school staff are interpersonal targets for the proposed research. Interpersonal factors influence the eating behaviors of adolescents indirectly by influencing intrapersonal characteristics.

Intrapersonal characteristics are those belonging to the individual who demonstrates the eating behavior. The nutrition knowledge, food preferences, attitudes about foods, and self-interests of adolescents are examples of the intrapersonal targets for the proposed research. These characteristics directly impact eating behaviors. They also influence interpersonal factors.

All of the components of the conceptual model work simultaneously to impact the eating behaviors of adolescents. The nature of eating behaviors in this conceptual model allows schools to be utilized as opportunistic environments in which an intervention can be implemented to target each specific influence of the model.

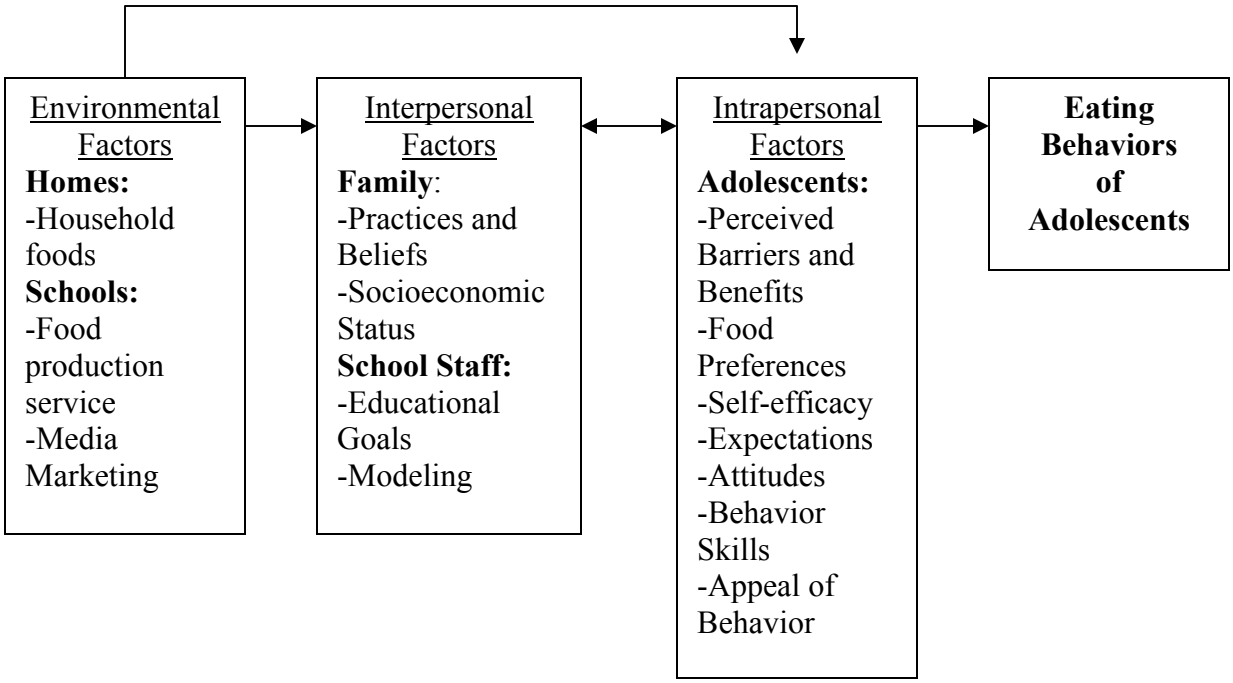

Figure 3.1. Conceptual model. A conceptual model was developed to identify environmental, interpersonal, and intrapersonal factors that directly or indirectly (as indicated by arrows) influence the eating behaviors of adolescents. These three categories of factors include specific influences (listed in the appropriate box), which are targets of school-based interventions to impact the eating behaviors of adolescents.

CHAPTER IV

PRELIMINARY RESEARCH

Previous research has shown that dietary intake among youth is not ideal for promoting lifelong health.[5-9] The diets of school-aged children are high in sugar, fat, and calories[5, 6] and low in fruits, vegetables, and dairy products.[7-9] These trends in dietary intake have been positively correlated to obesity prevalence among youth[5] and adults.[40, 110] Prior observational studies have investigated factors that influence eating behaviors of youth to better understand how interventions should be designed to improve these behaviors.[4, 21, 47] The impact of environmental and educational influences on eating behaviors have emerged as important characteristics to address in nutrition interventions.[4, 21] Schools provide environments where eating behaviors are developed[111, 112] and education is provided.[112] Thus, school food service systems and school curriculum are important targets for interventions.[112] School-based nutrition interventions may have the potential to substantially improve dietary intake trends among school-aged children.[112]

Although the food service systems and curriculums of public schools in the U.S. are governed by many of the same laws, many policies and procedures can differ by state or county,[113] resulting in regional differences in influences on eating behaviors. Therefore, it is important that school-based influences on student eating behaviors are studied at the local level throughout the nation.

A review of the literature (e.g., searching databases such as AGRICOLA and Web of Science) indicated that numerous school-based nutrition intervention studies have been conducted in at least fourteen states (CA,[18] LA,[18, 49] MN,[18, 51, 106] TX,[18, 50] NC,[17] GA,[87] MD,[12] IL,[13] WA,[16] CO,[15] NE,[113] NM,[115] SD,[115] AZ,[115] and MA[95]). Of these studies, only one was conducted in the local area of our research group in NC. This study, the Cardiovascular Health in Children (CHIC) Study, tested the impact of classroom interventions about "heart healthy" foods, exercise, and abstaining from smoking on decreases in cardiovascular disease risk factors among elementary school students.[17] There has not been adequate school-based nutrition research conducted throughout the U.S. Additional research is needed to provide evidence-based support for national laws that advance the school environment and promote school programs to improve dietary intake and decrease obesity prevalence among school-aged children.

To help fill this gap, two preliminary studies were completed in Guilford County, NC. The first study investigated school cafeteria influences on eating behaviors of students in Guilford County Schools (GCS). The second study investigated the process of conducting a school-based research project and pilot tested a cafeteria nutrition intervention. The Institutional Review Boards of The University of North Carolina at Greensboro (UNCG) and GCS approved both studies. The results of these two studies provided an understanding of influences on eating behaviors in GCS and of approaches to implement and test the proposed study, a comprehensive intervention to increase fruit, vegetable, and dairy product consumption and decrease obesity among students in GCS.

SCHOOL CAFETERIA OBSERVATIONAL STUDY

The first preliminary study was conducted as a component of a larger study, which was entitled *Healthy Eating Habits in Guilford County Schools*. This study was a collaborative project involving GCS and UNCG and was funded by the Centers for Disease Control and Prevention (CDC). The purpose of the larger study was to assess the overall environment affecting student nutrition in GCS. *Healthy Eating Habits in Guilford County Schools* had a cross-sectional design. Nine schools (e.g., three elementary, 40.1 % Caucasian; four middle, 37.5% Caucasian; and two high schools, 62.9 % Caucasian) agreed to participate. There were seven objectives of the study. The objectives were to gather data to assess the environment affecting student nutrition by completing: 1) administrator interviews, 2) the School Health Index, 3) cafeteria observations and interviews, 4) parent focus groups, 5) student focus groups, 6) a student survey, and 7) gather school performance data. One of the objectives of this study was completed by the Department of Nutrition, the cafeteria observations and interviews. Therefore, only this study objective is described. The purpose of the cafeteria observations and interviews was to assess how the eating environment and the individuals in that environment impacted food choices made by students during lunch at school.

Methods

Study Design. An exploration study was conducted in the 2001-02 academic school year to understand the nature of the interactions of students with their eating environment at

school. Qualitative data were collected through cafeteria observations and interviews with cafeteria managers and the Child Nutrition Coordinator for GCS.

Data Collection. One observation was completed per school (n = 8), lasting approximately one hour. One elementary school joined the larger study after all of the observations were completed and was not observed. Data collection utilized a cafeteria observation script with the following components: 1) lunch menu items, 2) aesthetics of the eating area, 3) physical layout of the cafeteria serving line, 4) order of foods provided on the food line, 5) number, type, and contents of vending machines in the eating area, 6) type and placement of a la carte items on the food line, 7) length of time for eating, 8) eating habits/characteristics of students, 9) presence of positive role models for healthy eating, 10) food preference statements from manager interviews and student comments, and 11) obstacles noted or other facts about the cafeteria. Observations were scheduled by appointment with the cafeteria managers.

Cafeteria managers were asked the following questions: "What are the favorite foods of students?" and "How do you feel about the nutrition services (e.g., foods) you provide to students?" The cafeteria food line was observed by first noting the foods present, their order, and techniques used for presentation. Students were then observed making food choices from the food line. The researcher observed the appearance of the cafeteria eating area, making note of the number, placement, and contents of vending machines and a la carte lines. Last, the researcher sat at a table occupied with students, made notes of what was on students' lunch trays and wrote down any comments students volunteered. Students were not interviewed. Data regarding school policies and

procedures were also collected through discussions with the Child Nutrition Coordinator for GCS.

Data Analyses. Qualitative data was organized so that characteristics were grouped by common themes, including differences between school levels (e.g., elementary, middle or high school), food venues, and the types of foods present. Grouping characteristics into common themes created categories of factors that influenced student food choices.

Results

Factors of the school food service system were found to impact food choices of school-aged children. These factors were grouped into four categories: policies and procedures, food availability and accessibility, employee perceptions, and the physical eating environment. (Several terms are used to describe the results and are defined in Appendix A.)

The first category includes influences of policies and procedures of the school food service system on student food choices. The purpose of this study was not to investigate school nutrition policy. However, through observations and interviews it became evident that the factors that influence student food choices are the result of or lack of policies and procedures. Policies and procedures were observed that were governed at the level of individual cafeterias/schools, the county, and nationally. At the level of individual cafeterias, cafeteria managers were observed making decisions regarding the foods that are available to students. For example, one cafeteria manager explained that he limited the number of dessert choices students could purchase a la cart, but in other cafeterias

dessert choices were ample. At the level of the county school system, the Child Nutrition Coordinator indicated that cafeteria managers had limited formal nutrition training. Cafeteria managers lacked formal nutrition training, because it was not required by policy. At the national level, competitive foods did not have policies governing their nutrient content or portion size. National School Lunch Program (NSLP) school meals had to meet one third of the macronutrient needs of students, following the Guidelines for Americans.[116] This provided guidelines for the average nutrient content of meals served, but no nutrient content guidelines for individual entrées or side items. As a result, high calorie and/or high fat entrée items were served through the NSLP, because they were needed for the NSLP school meal to met the protein requirement. At the county and national levels, the resources provided to school cafeterias were limited. Time, money, training, and space were limited in the cafeterias, resulting in the use of many prepackaged, precooked foods.

As a result of policies and procedures (or lack of), foods were made available and accessible to students. Thus, the second category influencing food choices included factors impacting food availability and accessibility. These factors included: the types of foods available, the financial status of students, food price, and convenience. Three main types of foods were available in school cafeterias: NSLP, vending machine, and a la carte foods. NSLP foods included more fruits, vegetables, and dairy products than a la carte and vending machine foods (Table 4.1). For example, NSLP options included nutrient-dense foods such as milk, bananas, chef salad, and green beans. However, foods of lower nutrient density (i.e., French fries, biscuits) were also available through the NSLP. A la

carte and vending food items were ample and included very few healthy items (Tables 4.2 and 4.3). For example, a la carte and vending items included non-carbonated soft drinks (e.g., Fruitopia, PowerAde, Chiller), cookies, and sweet rolls (e.g., Big Texas Cinnamon Roll). The number of items available that were not nutrient-dense increased from elementary to middle to high schools.

The portion sizes of food choices available at schools varied among foods and beverages. For example, beverages served as components of the NSLP were either 4 oz (e.g., 100% juice) or 8 oz (e.g., milk). A la carte and vending machine beverages ranged from 12-20 oz. The only nutrient-dense beverage observed in larger portion sizes was milk, which was only available on the food line and not in vending machines. Foods offered in the NSLP were in smaller portions than a la carte and vending machine items. For example, fruit cobbler was sold as a component of the NSLP meal as only 4 oz, but the same item was offered a la carte in an 8 oz portion for a low price of $0.50.

Financial status affected food accessibility, because students from families of lower incomes qualified for free or reduced lunch prices (e.g., family income < 130% of the poverty line, free; 130-185% of the poverty line, reduced to $0.40; > 185 % of the poverty line, $1.55).[27] Qualification for free or reduced-price lunch increased availability to the foods offered from the NSLP, such as fresh fruits and vegetables, milk, and 100% juice. The amount of money that a student's parents gave him/her to purchase foods at school also affected foods accessible to them. Information from interviews with cafeteria managers and the Child Nutrition Coordinator indicated that money deposited in a child's school meal account or money that the student had in hand could be used to purchase any

foods from the NSLP, a la carte line, or vending machines. Hence, the amount of money that is accessible to the student affects the type and amount of food a child is able to purchase. Similarly, price affects food accessibility. The researcher witnessed two middle school students choosing one a la carte item over another based on a price difference of only $0.05.

Finally, convenience affects food accessibility. Students have a limited amount of time to obtain and eat their food. We observed that most students had sufficient time to eat their lunch, with time remaining after eating to socialize. Food was made convenient in numerous vending machines throughout the cafeteria in middle schools (e.g., at least two per school) and high schools (e.g., at least three per school). Elementary schools did not have vending machines. Food placement on the food line may have influenced the convenience of foods. Healthy foods such as milk, fruits, and vegetables were often placed last on the food line. These healthy foods were difficult to see, being displayed in deep metal bins and coolers. Foods that were commonly first on food lines included pizza, hamburgers, French fries, and fruit cobbler.

In addition to observations of the cafeteria, the researcher also interviewed cafeteria managers. From these interviews, the third category influencing student food choices emerged, employee perceptions. Employee perceptions were recorded regarding the foods students like and the role of the cafeteria in feeding students. Managers perceived that students liked foods such as pizza, French fries, carrots with dip, and cookies, because managers observed students buying them often. Managers said that students complain that the milk served from deep metal bins in the NSLP is not cold.

Differences were observed between the perceptions of elementary and middle/high school managers when asked about the nutrition services they were providing to students. Elementary cafeteria managers gave the impression it was important for students to choose fruits and vegetables daily and limit sweets. They also said that they encourage students to make healthful choices. Middle and high school managers gave the impression they felt they were providing good nutrition services by offering foods the students like, regardless of the nutrient or energy content.

The last of the four categories is the impact of the physical environment of cafeterias on student food choices. Positive environmental characteristics that may support healthy food choices included natural light, pleasant views, ample space, nutrition education displays, positive role models, and clean eating areas. Positive characteristics observed in elementary schools included: 1) teachers and staff encouraging students to make healthy food choices, 2) teachers and parents eating with students, and 3) the presence of nutrition education displays. Few positive characteristics were observed in middle and high school cafeteria eating areas. Negative characteristics of middle and high school cafeteria environments included: 1) few windows, 2) cramped seating, 3) plain concrete walls, 4) lack of nutrition education displays, 5) absence of healthy eating role models, and 6) an unclean eating area.

Discussion

As a result of the cafeteria observations and interviews, the researcher developed an understanding of the cafeteria influences on eating behaviors in GCS. Policies and

procedures (or the lack of policies and procedures) impacting the availability and accessibility of foods were important influences. Food availability and accessibility differ in that foods that are present in an eating environment are available; however, not all individuals may access those foods equally. For example, a prior study showed that availability and accessibility of fruits and vegetables in schools is positively associated to fruit and vegetable intake at school.[117] The NSLP was the primary source for fruits and vegetables in the cafeterias. Students who were qualified to receive the NSLP school meal for free or at the reduced price may have had greater access to the healthy foods provided in the NSLP, because they paid less.

Healthy food choices must be available and accessible, but they must also be appealing.[49, 50] Managers in this study said that students complained that the NSLP milk served from deep metal bins was not cold. This negatively affects taste and subsequent consumption.[118] Future studies should develop marketing campaigns for schools to increase the appeal of milk.

A la carte and vending machine foods were ample in the observed middle and high school cafeterias. These foods competed with NSLP items, and were high in fat, sugar, and/or calories. Other studies have found this as well.[67, 119] Portion sizes of competitive foods were not regulated. This is a problem, because competitive foods appeal to students[120] and replace healthier items sold in the NSLP.[59] For example, Kubik et al.[59] found that a la carte availability was inversely correlated with fruit and vegetable consumption and positively correlated to total and saturated fat intake in middle schools. Vending machines providing snacks were also negatively correlated to fruit intake.[59]

The researcher observed that the availability of a la carte and vending machine items increased from elementary to middle to high schools. A national school food service study also reported that middle and high schools are more likely than elementary schools to offer a la carte and vending machine items.[121] Several studies note that this problem warrants greater attention.[11, 67, 69, 70, 118-120] Future studies should remove competitive foods from schools and conduct cost-benefit analysis on changes in food service revenue and student food choices.

There were no policies or procedures in GCS requiring cafeteria mangers to be formally trained in nutrition. Yet, cafeteria managers were responsible for making decisions regarding how many a la carte choices were available on the food line. In general, the perceptions of elementary school managers promoted and those of middle/high school cafeteria managers did not promote students choosing healthy foods. Thus, formal nutrition training could improve the perceptions of cafeteria managers and positively impact the foods available in schools. This tactic has been suggested for school administrators as well.[120]

Cafeteria eating areas in this study lacked positive role models, nutrition education, and pleasant environments. These factors have been indicated to promote healthy food choices.[120] Future studies should include interventions to promote positive role models, nutrition education, and pleasant environments in school cafeterias, especially in middle and high schools.

This study was limited for several reasons. Only eight schools were observed. Although these schools included elementary, middle and high schools, the schools

observed represented less than 10% of GCS. The observations were also brief, approximately one hour. Longer observations of a greater number of schools might reveal additional information. The interviews only included two questions. These questions served as a starting point. Focus groups with cafeteria managers would provide more information about the perceptions of cafeteria managers regarding school food service. There were no data collection procedures for discussions with the Child Nutrition Coordinator. Again, these discussions served as a starting point. Detailed procedures with specific questions regarding school food service would have provided more information, including a thorough investigation of policies and procedures. The researcher did not interview school principals to gather their perceptions. Because policies and procedures can be made at the school level, the perceptions of school principals could provide insight for assessing current policies and planning interventions. Finally, the purpose of this study was to assess how the eating environment and the individuals in that environment impacted food choices made by students during lunch at school. This study did not investigate the prevalence of nutrition education delivered through classroom curriculum or its impact on eating behaviors. An additional assessment of nutrition education in the school curriculum would provide a better understanding of how the entire school environment, not only the cafeteria environment, influences student food choices.

Applications

This study provided useful information regarding the impact of a variety of factors related to the cafeteria environment and school food service system in general. This

information was collected from schools in the GCS district and, therefore, provides a starting point from which interventions can be developed for GCS. The researcher identified milk as a healthy food choice that could be better marketed to students as an appealing beverage opposed to soft drinks in the cafeterias. This concept was the basis for the second preliminary study.

MILK VENDING PILOT STUDY

It is well documented that cafeteria environments in secondary schools provide soft drinks that are high in sugar and calories.[67, 119-121] The prior observational study concurs with what is documented in the literature. The availability of these beverages is a problem, because diets that are excessive in sugar and calories contribute to obesity.[5, 120] The presence of soft drinks in school cafeterias is inversely associated with the consumption of milk.[5] Thus, interventions are needed to decrease the consumption of soft drinks and increase the consumption of milk.

Milk is a primary source of calcium in the diet, an important mineral for peak development of bone mass during youth.[36] The consumption of calcium-rich foods is related to lower body fatness in youth and adults.[9, 37-39] Other research groups have hypothesized that calcium, as well as many other bioactive components of dairy products, have anti-obesity activities in the body.[39] For example, dairy product consumption is inversely related to insulin resistance syndrome among overweight young adults.[40]

Despite the compelling support for dairy products as a component of a healthy diet, intake among adolescents does not meet recommendations.[44] Milk is one of the five main

components in a NSLP school meal.[60] However, in the observational study, cafeteria managers stated students complained that the milk is not cold. Although milk served in schools follows safe food guidelines, the presentation techniques are less than appealing. Milk is sold in 8 oz cartons from stainless steel cooler bins. In contrast, soft drinks are packaged in appealing 12-20 oz plastic bottles designed for adolescents[122] and sold from glass front coolers and in vending machines throughout the cafeteria.[67, 119]

To address this issue, school-based interventions are needed. A milk vending pilot study was conducted entitled, *Increasing Milk Consumption in GCS (NC)*. This study was funded by the Institute of Nutrition. The original purpose of this study was to investigate associations between dairy food choices and the prevalence of overweight and to investigate the effectiveness of a nutrition education and environmental intervention to increase milk consumption among middle school students in GCS. However, after the study concluded it became evident that the milk pilot study served a different purpose. This pilot study served as an opportunity to identify the limitations and weaknesses of the study methods and to establish a rapport with school employees, especially administrators. Due to the invasive nature of intervention versus observational research, this purpose proved to be essential in making the proposed study possible.

Methods

Study Design. This study had a cross-sectional design. Interventions were implemented in middle schools because their cafeteria environments have more negative influences on food choices than those of elementary schools (e.g., access to vending machines, fewer

role models). High schools were not chosen because cafeteria influences on food choices are more complex (e.g., higher prevalence of competitive foods, more cramped spaces, students eating lunch off campus) than those of middle schools. Four (of eighteen) schools agreed to participate. Schools were paired by socioeconomic status (SES, high = less or low = more than 50% of the school population qualified for free or reduced lunch prices). School pairs (e.g., one high and one low SES) were randomly assigned to control or intervention treatment after principals gave written agreement to participate. The study spanned the 2002-03 academic school year. Educational and environmental nutrition intervention components were implemented to increase the appeal and availability of milk in the school cafeterias.

Selection of Participants. After schools were assigned to treatment or control groups, one sixth, seventh, and eighth grade physical education (PE) class were randomly selected from each school (e.g., total of twelve classes). PE teachers provided study information accompanied by a consent form to students from the selected classes (N = 345). Teachers encouraged all students to return the form to decrease bias caused by motivated students and parents, who are more likely to return the form. Parental consent and child assent were required for students to participate. Approximately 42% of students (N = 143) returned consent and participated in data collection.

Data Collection. Following recruitment of participants, baseline measurements were taken. The researchers created a dairy food frequency questionnaire (DFFQ) by modifying (with permission of the author) the Youth/Adolescent Food Frequency Questionnaire (YAQ), which has been shown to be reproducible and valid for measuring

dietary intake in diverse adolescent populations.[92] The DFFQ was used because adequate funding was not available to purchase the YAQ and its analysis. The DFFQ included questions from the YAQ regarding consumption of dairy products and foods including dairy products that provided at least 50 mg of calcium per serving. Additional questions were added to give insight as to the location, percent fat, and flavor of milk consumed, including:

- "Where do you usually eat breakfast during the school week (Mon.-Fri.)?"
- "At lunch do you usually… a) bring your lunch; b) eat a school meal; c) eat from vending machines; d) eat a la carte items; or e) don't eat lunch?"
- "What type of milk do you usually drink at home?" and "…at school?"

The DFFQ reported dietary intake over the past month. A display board was used to prompt students to recall the percent fat of the milk they usually drank at home and to teach students serving sizes of milk and other dairy products. Samples of milk containers found at school were provided to help student visualize what type of milk they drink at school. Prior to the start of the pilot study the DFFQ was tested for content validity by administering the DFFQ to six middle school students, including two students from each grade, males and females, and varying ethnicities. Students were asked if they understood all of the questions and if there were any foods they ate often that had dairy products in them that were not on the questionnaire. Student comments were used to improve the questionnaire. The DFFQ was not tested for reproducibility or validated for dietary intakes of students prior to administering the questionnaire in the pilot study. Before administration of the questionnaire, students were informed that they were "participants

in a study to learn about what middle school students eat in order to make foods better in schools."

A trained research assistant measured height (cm) and weight (kg) using a portable stadiometer and a calibrated digital scale, respectively. A note was made for students wearing particularly heavy clothing and one kg was subtracted from their weight. Age (y) was assessed by student reports. Body mass index (BMI) was calculated using these data in kg/m^2. BMI-for-age percentiles were determined by plotting BMI and age on the 2000 CDC growth charts. CDC definitions were used to identify students that were "at risk of overweight" (BMI-for-age $\geq 85^{th}$ percentile and $< 95^{th}$ percentile) and "overweight" (BMI-for-age $\geq 95^{th}$ percentile).

Intervention Components. After baseline data were collected, the environmental and educational interventions were implemented in the two treatment schools. Interventions included obtaining large, bottled, flavored, 2% or less fat milk products from the school system's dairy distributor and providing these products in milk vending machines in the cafeteria eating areas where they could compete with soft drinks. These products could also be purchased on the food line.

Two Dixie-Narco, glass front vending machines were chosen based on recommendations from the South East United Dairy Industry Association. The vending machines were leased from and installed by Brady Distributing (Charlotte, NC). GCS maintained the machines. One cafeteria staff member was designated by the cafeteria manager at each school to stock the vending machine with the aforementioned milk products. Water and 100% juice were also sold from the vending machines.

A milk taste-testing activity was completed in the cafeteria where students could taste the new milk products. This tactic was used to increase the likelihood that students would change their beverage choice behaviors.[123] The day of the taste-testing, a dairy product trivia sheet was also distributed. Students returning the trivia sheets were entered into a contest. Students scoring the highest on the trivia received "got milk" shirts, pens, and key chains. Outcome measures were repeated at the conclusion of the school year for both the intervention and control groups (N=140).

Data Analyses. Time and funding constraints prohibited validation of the DFFQ for measuring dietary intake of dairy products and calcium among participants. For this reason, calcium and dairy product intake could not be reported and the impact of the intervention could not be tested. Responses to questions regarding the location, percent fat, and flavor of milk consumed by participants were analyzed. Responses to these questions and BMI-for-age classification (e.g., normal or at risk of overweight/overweight) provided categorical data that was analyzed using Chi-square analysis. Statistical significance was defined as $p \leq 0.05$.

Results

At Risk of Overweight/Overweight Prevalence. At baseline, 18% of the participants were at risk of overweight and 20% were overweight. More than 9% of participants had BMI-for-age values that were greater than the 100th percentile.

Eating Behaviors. Students responded on the DFFQ to the question, "Where do you usually eat breakfast during the school week (Mon.-Fri.)?" Of respondents (N=140), the

majority (69.2%) reported eating breakfast at home and almost 22% reported not eating breakfast at all. Chi-square analysis indicated significant ($p < 0.001$) differences between the weight status of breakfast eaters (e.g., "at home" or "at school") and non-breakfast eaters (e.g., "don't eat breakfast"). A higher percentage of participants who avoided breakfast were at risk/overweight compared to those who ate breakfast. Among breakfast eaters (N=109), 70% were normal weight and 30% were at risk/overweight, regardless of whether breakfast was obtained at home or at school. The inverse was true for non-breakfast eaters (N=31), with 32% classified as normal weight and 68% as at risk/overweight.

The second question on the DFFQ asked, "At lunch do you usually… a) bring your lunch; b) eat a school meal; c) eat from vending machines; d) eat a la carte items; or e) don't eat lunch?" Students were asked to indicate what the majority of their usual meals consisted of from the aforementioned list. The majority (67.8%) of respondents reported usually eating a school meal at lunch. About one-fourth of participants reported bringing their lunch to school. Five participants (3.5%) indicated that they usually eat their lunch from the cafeteria vending machines. Chi-square analysis did not identify significant differences between weight status and responses to this question. However, significant ($p = 0.046$) differences were observed between normal and at risk/overweight prevalence among students who either reported bringing their lunch or eating foods provided by the school cafeteria (e.g., condensing NSLP school meals, a la carte items and vending items into one variable). Seventy five percent of students reported eating

foods provided by the school cafeteria. A significantly higher proportion (43%) of these participants were at risk/overweight compared to students bringing their lunch (24%).

Two questions on the DFFQ asked, "What type of milk do you usually drink at home?" and "…at school?" Chi-square analysis revealed that the types of milk consumed at home were significantly ($p < 0.001$) different than the types consumed at school (Figure 4.1). More students reported that they consumed whole milk at home (36.4%) compared to at school (6.6%); 2% milk at home (37.8%) compared to at school (20.2%); and skim milk at home (11.2%) compared to at school (2.0%). Fewer students reported that they consumed 1% milk at home (7.7%) compared to at school (44.8%). Fewer students also reported that they did not drink milk at home (4.9%) compared at school (22.4%).

The majority of participants (63%) reported drinking whole, 2%, or 1% milk both at home and at school. Cross tabulations of these three predominant choices identified significant ($p = 0.002$) differences in the type of milk participants reported consuming at home compared to at school (Figure 4.2). Approximately 77% of participants that reported consuming whole milk at home reported choosing 1% milk at school. Almost half of the respondents who reported consuming 2% milk at home reported choosing 1% milk at school.

Discussion

This pilot study sought to investigate the impact of an intervention to promote milk consumption on dairy product/calcium intakes among adolescent. Although the impact of

the intervention was not able to be determined, several characteristics of the population were elucidated. First, 20% of the participants in this study were overweight. This is a concern, because this prevalence rate is greater than the most recent national estimate of 15%.[1]

Several eating behaviors were associated with at risk of overweight and overweight status. Participants who were at risk of overweight or overweight appeared to avoid breakfast, a key meal for nourishment, especially calcium. Skipping meals can also lead to overeating of unhealthy foods throughout the rest of the day.[124] Students who brought their lunch appeared to have a lower prevalence of at risk/overweight than those who ate foods from schools. The mediators between these eating behaviors and the weight status of participants are unclear. Future research should include measures such as SES, knowledge, and attitudes to better elucidate the influences on eating behaviors that are evaluated.

Milk consumption was the targeted behavior for this study. Significant differences in the percent fat of milk that students chose at home compared to at school were observed (i.e., 77% of participants who drank whole milk at home drank 1% at school). A high percentage (22%) of students reported not drinking milk at school. These data support the need for future research to better determine what influences student beverage choices. Do more students not drink milk at school than at home, because there are appealing alternative beverages (e.g., soft drinks) at school? Is milk consumption different at home verses at school, because the milk at school is different than the milk at home (e.g., lower fat and flavored milk is more available)? Providing 1%, flavored milk

instead of white, whole milk helps reduce the saturated fat content of children's diets. However, schools must consider that providing milk beverages different from what students have available at home may also increase the number of students who do not drink milk at school. Conducting focus groups among these students could provide insight into the milk consumption behaviors of students. Projects that address the motivation of the individual to choose certain beverages at school will be essential in promoting ideal nutrition for every student through school food service.

One other study has also targeted milk consumption. Like the study by our group, "1% or Less" was a pilot test. However, it was a community-based campaign to encourage low fat milk consumption to decrease the saturated fat content of diets of residents.[100] The "1% or Less" campaign included paid advertisements, public relation efforts and educational programs. Although this program was community-based it included a school-based component. Educational interventions were delivered to students in elementary, middle, and high schools and included taste-testings and contests for students in schools. As a result of the "1% or Less" campaign overall milk sales increased by 16% in intervention cities. The authors noted that their study was different from most nutrition education programs because it focused on the whole community. They also noted that campaigns like "1% or Less" are needed because other community campaigns are implemented by the milk industry and promote milk consumption in general, not lower fat milks. Promoting lower fat milk consumption is important to lower the overall saturated fat content of diets in the U.S.

This study had many limitations. The questionnaire used was not valid for measuring the impact of the intervention. Age was measured in years. Measuring age in months would have provided more accurate estimates of BMI-for-age. The ethnicity of the participants was not assessed; thus, it is unknown if the study population was representative of middle school students in GCS. Therefore, the findings may not be applicable to the general middle school population in GCS.

Applications

This study served several purposes that were unforeseen by the researchers prior to implementation. First, this study provided the primary investigator with the opportunity to develop a rapport with school staff and administrators. Developing a rapport lead to administrative and financial support from GCS to develop a more comprehensive intervention program. Second, implementing a pilot study allowed the strengths and weaknesses of the study methods to be learned. Understanding the best practices for implementing and evaluating an intervention is essential for the intervention to be successful. Thus, although the original purposes of the study were not met, this pilot study served alternate purposes that were crucial to the development and funding of the proposed research.

Table 4.1. Observed high school National School Lunch Program (NSLP) meal choices.[£]

Menu Item	Component*	Healthy[∞]	Moderate	Not as Healthy
Salisbury steak + biscuit	Bread and meat		¤	
Chef salad	Bread, meat and vegetable	¤		
Pizza§	Bread and meat			¤
French fries§	Vegetable			¤
Green beans	Vegetable		¤	
Salad cup	Vegetable			
Banana	Fruit	¤		
4 oz. Juice	Fruit			
8 oz. Milk	Milk	¤	¤	
Number of Components*→		**5**	**4**	**3**

[£] A single one hour observation of a high school cafeteria in GCS. This observation was one of eight observations, two of which were in high schools. Table indicates the meal choices observed that could be purchased as components of a NSLP meal at one high school.

* Students must choose at least three but, no more than five components for school lunch price.

§ In high schools, pizza and fries were offered every day. (Middle schools offered pizza and fries once per week and elementary schools offered them once a month.)

¤ Indicates food choice combinations that could be purchased and considered: "healthy", "moderate", or "not as healthy".

∞ "Healthy" combination provides more nutrients per 1000 calories[125] of the meal than the "moderate" and "not as healthy" combinations.

Table 4.2. Examples of macronutrient content and portion sizes of vending machine items[£]

Item	Purchase Size (oz)	kcal	Fat (g)	Sugar (g)
Fruitopia	12	170	0	45
PowerAde	20	175	0	45
Cookies	1.75	280	14	20
Donuts, mini powdered	2.5	290	14	21
Fritos Corn Chips	2.25	300	18	2
Pop tarts	3.7	420	10	37
Big Texas Cinnamon Roll	4.0	470	25	31

[£]Vending machines were present in middle and high school cafeterias, but not in elementary school cafeterias. Vending machine items were determined to generally be low in nutrient density, high in percent calories from fat and/or sugar. Each item in this list provided at least 54% of calories from fat and/or sugar. Healthy alternatives were not present in vending machines.

Table 4.3. Examples of macronutrient content and portion sizes of a la carte items[£]

Item	Purchase Size	kcal	Fat (g)	Sugar (g)
Chiller Beverage	20 oz	275	0	70
Brownie	1 ea.	321	13	36
Grandma's Cookies	2 ea.	400	18	28
Pudding Parfait	12 oz	537	24	58

[£]A la carte items were available at elementary, middle and high schools (n = 8). A la carte items were generally low in nutrient density and high in percent calories from fat and/or sugar. Each item in this list provided at least 54% of calories from fat and/or sugar. Healthy alternatives were not present.

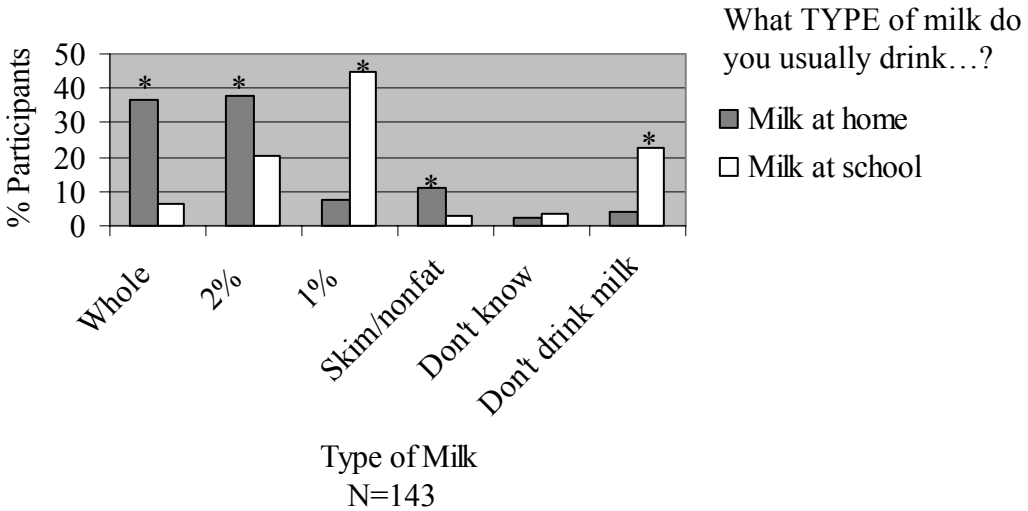

Figure 4.1. Type of milk consumed "at home" verses "at school" reported on the dairy food frequency questionnaire. Percent of respondent (N=143) answers to the questions, "What type of milk do you usually drink at home?" and "What type of milk do you usually drink at school?" A cross tabulation with a Chi Squared test for significant associations between variables was completed for the variables whole milk, 2% milk, 1% milk, skim/nonfat milk, don't know, and don't drink milk for the questions: "What type of milk do you usually drink at home?" compared to "What type of milk do you usually drink at school?" Differences were tested at a significance of $p \leq 0.05$.
* Values with a star are significantly ($p<0.001$) higher between the adjacent bars.

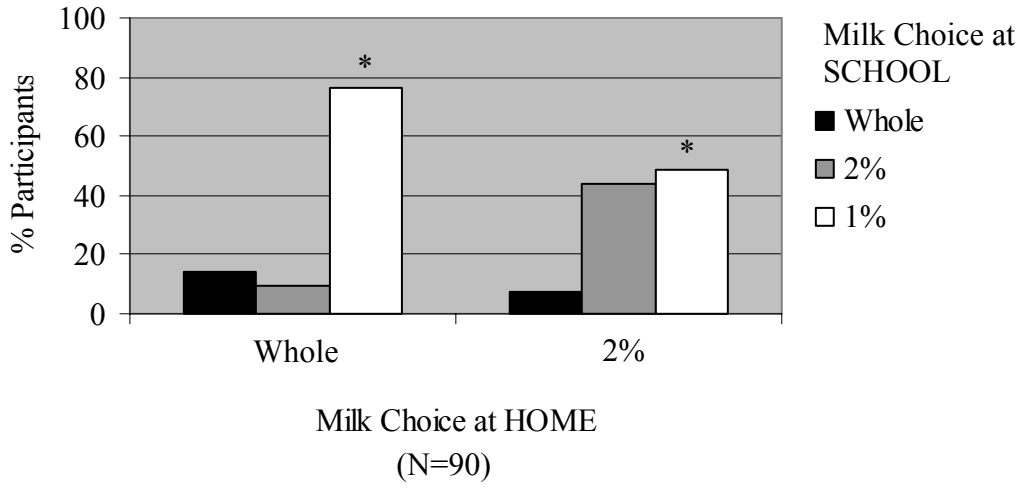

Figure 4.2. Whole, 2%, and 1% milk choices reported on the dairy food frequency questionnaire at home compared to school. Respondents (N=143) answered the questions, "What type of milk do you usually drink at home?" and "What type of milk do you usually drink at school?" Of the possible responses (e.g., whole milk, 2% milk, 1% milk, skim/nonfat milk, don't know, don't drink milk), the majority of respondents (N= 90) answered "whole milk", "2% milk", or "1% milk" for both questions. Because the proportion of participants answering "whole milk", "2% milk", or "1% milk" varied between the two questions, a cross tabulation with a Chi Squared test for significant associations among responses between the two questions was completed. Differences were tested at a significance of $p \leq 0.05$.
* Significant (p=0.002) differences were reported by participants between the type of milk consumed at school and the type of milk consumed at home.

CHAPTER V

DEVELOPMENT OF *HEROS*: A SCHOOL-BASED NUTRITION INTERVENTION FOR ADOLESCENTS

This chapter was prepared as a manuscript for submission to *Health Education and Behavior*.

ABSTRACT

A one-year, nutrition intervention called *Healthy Eating to Reduce Obesity through Schools (HEROS)* was implemented to increase fruit, vegetable, and dairy product consumption and decrease obesity prevalence among seventh grade students (N = 489, 55.1% female, 51.6% White). Six middle schools (e.g., three matched pairs) in Guilford County, North Carolina were randomized to control or treatment conditions. The intervention was designed based on a conceptual model that consisted of concepts from the Social Cognitive Theory, an ecological model of health behavior, and social marketing. The intervention included cafeteria, classroom, and family/school staff nutrition education and cafeteria food improvements. The development of the intervention is explained to better understand how the implemented intervention may impact eating behaviors of students. The use of observations, student surveys, and analyses of the reach and barriers of the program are also described.

INTRODUCTION

Obesity prevalence among our nation's youth is high and increasing at an alarming rate.[1] Inadequate consumption of healthy foods[2-4] and over consumption of foods high in sugar, fat, and calories are important contributors to obesity among youth[5, 6] Research shows that as youth move from elementary to middle school, their intake of fruits, vegetables, and milk decreases.[7] Consumption of these healthy foods is inversely associated with obesity[5] and cancer.[8] Thus, it is important that public health initiatives improve eating behaviors and increase the consumption of fruits, vegetables, and dairy products.

Schools are acknowledged for having a strong influence on the eating behaviors of students and are opportunistic environments to develop interventions to improve nutritional intake and decrease obesity prevalence.[9, 10] Interventions designed based on health behavior theory explaining the complex, multi-level influences on eating behaviors are most likely to result in behavior changes.[11] Several recent school-based interventions have used health behavior theories to design multi-level interventions and have been successful in increasing the consumption of fruits and vegetables and decreasing obesity among adolescents.[11-13] The TEENS,[11] Gimme 5,[13] and Planet Health[12] interventions used the Social Cognitive Theory to design environmental and educational interventions to increase fruit and vegetable consumption among adolescents. These studies not only reported the outcomes from implementing their interventions, but also described the design and implementation of the intervention.[12, 13, 16]

Understanding how an intervention was designed and implemented helps explain how it results in outcomes.[13] The quality of intervention implementation and the barriers

faced and overcome are important factors to consider.[14] The purpose of this research is to describe the conceptualization and implementation of the *Health Eating to Reduce Obesity through Schools (HEROS)* intervention to contribute to a better understanding of how the *HEROS* intervention may result in behavior change.

Background

The *HEROS* intervention was a collaboration of two community programs sponsored by the North Carolina Department of Health and Human Services, *Team Nutrition* and *Eat Smart, Move More…North Carolina*. Seventh grade students (N = 489) in six middle schools (e.g., three pairs matched for income level and ethnicity) in Guilford County Schools in North Carolina who provided informed consent (Appendix B) participated. *HEROS* was a one-year nutrition intervention program to increase fruit, vegetable, and dairy product consumption and decrease obesity prevalence among adolescents. Participant demographics were 55.1% female, 51.6% White, 36.3% African American, and 12.1% other (e.g., Hispanic, American Indian, Asian, and Multi-Racial). One school from each matched pair was randomly assigned to intervention or control treatments.

Conceptual Model

The *HEROS* intervention was designed from a conceptual model (Figure 5.1) based on concepts from the Social Cognitive Theory,[15] an ecological model of health behavior,[15, 16] and social marketing.[15] These health behavior concepts have been previously used individually and paired[11-13, 16, 17] to design nutrition interventions. In the conceptual

model, eating behaviors of adolescents are the target behavior. Three categories of factors influence the eating behaviors of adolescents: environmental, interpersonal, and intrapersonal factors. Specific influences that were targets for the *HEROS* intervention are listed in the appropriate categorical boxes in Figure 5.1. All of the components of the conceptual model work simultaneously to impact the eating behaviors of adolescents. The nature of eating behaviors in this conceptual model allows schools to be utilized as opportunistic environments in which an intervention can be implemented to target each specific influence of the model.

Using this conceptual model, the *HEROS* intervention was designed to impact ecological influences (e.g., home and school), the relationships between these environments, and interpersonal and intrapersonal dynamics of behaviors within these environments. The *HEROS* intervention was also designed to capture the attention of adolescents by addressing their self-interests through social marketing techniques.

METHODS

The individuals involved in planning and implementing the intervention (e.g., personnel resources), the design of educational resources, and the components of the *HEROS* intervention are described. Measures used to evaluate implementation included observations, a survey to assess student awareness, and analysis of the reach of the intervention into the population and barriers encountered and/or overcome.

Personnel Resources

Personnel were defined as primary and secondary implementers. The primary implementers of the *HEROS* intervention were a collaboration of university, county school, and county health department employees, including the primary investigator (PI), four health educators, and two dietitians. This collaboration planned, implemented, and assessed intervention implementation. Secondary implementers include cafeteria staff and research assistants. The managers of the three intervention cafeterias implemented interventions involving the food and nutrition education available in the cafeterias. Research assistants assisted primary implementers with implementing and assessing intervention components.

HEROS Intervention

The *HEROS* intervention was implemented in three middle schools over 23 weeks. Control schools received no intervention. The *HEROS* intervention had three components: 1) cafeteria environment: nutrition education and food availability, 2) nutrition education: family/school staff, and 3) nutrition education: classroom.

Component 1. Cafeteria Environment. Intervention components delivered through the cafeteria environment included nutrition education, increasing the availability of fruits, vegetables, and dairy products, taste-testings, and giveaways. The primary implementers designed twenty-six nutrition message cards using social marketing techniques to help students make connections between the foods they choose at lunch and how healthy foods support a healthy body.[11, 15] Messages addressed interests of adolescents. For

example, nutrients in fruits, vegetables, and dairy products were related to healthy skin and a lean body. Messages also addressed the importance of moderating portion sizes and limiting soft drinks, snacks, and desserts high in sugar, fat, and calories. These messages were designed to make fruit, vegetable, and dairy product choices more appealing and competitive choices less appealing by increasing the nutrition knowledge and improving the attitudes and beliefs of students regarding healthy choices. The nutrition message cards were displayed at point of service locations. Educational posters, hanging displays, and window decals promoting fruits, vegetables, dairy products, and healthy portion sizes were installed on the walls in the food line and in the eating areas to impact student awareness of healthy choices.

One milk and one fruit and vegetable taste-testing were conducted per school to allow students to demonstrate choosing healthy foods and to learn about the benefits of those foods, which were available in the cafeteria. Merchandise that promoted fruits, vegetables, and dairy products (e.g., *got milk* from the Southeast United Dairy Industry Association and *5 A Day* available at www.shop5aday.com) were given away to students who made healthy choices through the taste-testings and raffles. These activities were designed for students to associate a positive experience with choosing healthy foods available in the cafeteria.

The availability of fruits, vegetables, and dairy products were increased in the cafeteria environment using product and placement techniques from social marketing.[15] Appealing reduced-fat or less, bottled milks were made available in three flavors (e.g., plain, chocolate, and strawberry). Standing, glass door coolers replaced stainless steel

milk bins to increase the visibility, coldness, and appeal of carton and bottled milk. Five new fruit and vegetable side items were introduced into the menu: Ambrosia, Carrifruit Salad, Italian Pasta, Tomatoes and Cucumbers, and Cran-Apple Waldorf Salad. The new menu items were available as components of the National School Lunch Program meal and could also be purchased a la carte on the food line and in the eating area from a la carte lines and food carts. They were served at least twice per week during the second half of the intervention and were advertised using color flyers distributed to school staff. A wider variety of whole fruits and vegetables were offered daily to provide more choices for students. To increase variety, pre-intervention produce orders were assessed for quantities and types of fruits and vegetables ordered. Then, a new goal was created for produce ordered during the intervention, including new items such as pre-sliced apple bags and vegetable cups.

Component 2. Nutrition Education: Family/School Staff. Free, healthy dinners were given after school to families and school staff with educational speakers discussing the obesity epidemic and healthy eating. Two events were held per school. To increase participation, especially from families/staff not motivated to seek nutrition information, the events were coupled to other school events (i.e., basketball game, literacy tutoring, Parent Teacher Association meeting). Sending flyers home with students and making school announcements also advertised the events.

The first event at each school promoted milk as a healthy beverage and emphasized the effects of consuming soft drinks and large portion sizes on poor nutrition and body weight. The dinner included spinach salad, low fat chicken Alfredo pasta, apple

crisp, and milk or unsweetened tea. The second event at each school encouraged families to choose five to nine fruits and vegetables a day for good health (*5 A Day*). The second dinner included spinach salad, Italian vegetable pasta, apple crisp and milk or unsweetened tea. Three pamphlets were distributed: *Soft Drinks and School-aged Children* (event one), *Portion Sizes and School-aged Children* (event one, Appendix C), and *5 A Day the Color Way* (event two, available at www.shop5aday.com). Handouts providing nutrition education on how to improve the diets of the entire family and how to encourage students to choose healthy foods and drinks at school supplemented these pamphlets. Individuals were able to discuss these topics with nutrition educators and dietitians at no charge. Merchandise promoting healthy eating (i.e., *got milk* and *5 A Day*) was raffled off to reinforce healthy eating behavior changes with a positive experience. Following these events the pamphlets were mailed (two separate mailings) to the families of all the students and were distributed to the faculty and staff at the schools.

Component 3. Nutrition Education: Classroom. To further impact knowledge, attitudes, and behaviors of students regarding fruit, vegetable, and dairy product consumption, a nutrition educator taught a 45-minute nutrition lesson to all seventh grade students through their science curriculum. The lesson was designed based on the Social Cognitive Theory and social marketing and utilized several modes of learning, including listening, watching, speaking, reading, and writing. A pre- and post-lesson activity accompanied the science lesson. Prior to the nutrition lesson, a nutrition educator quizzed students on fruit, vegetable, and dairy product knowledge and gave away merchandise (i.e., *got milk* and *5 A Day*) in the school cafeteria. The purpose of this activity was to

create a connection between the nutrition education they would receive in class and making food choices in their school cafeteria. Following the pre-activity, classroom nutrition education emphasized the connection between the foods students eat and the functions of foods in the body. In addition to advocating fruits, vegetables, and dairy products, this lesson also discussed how and why body mass index is used to identify healthy body weights and the differences between unhealthy portion sizes and correct serving sizes of foods. The lesson was delivered through an interactive spinning wheel game with prizes. Students completed a crossword puzzle and a short quiz after the game. The week following the classroom lesson, the science teachers completed a *5 A Day Challenge* activity with their science classes. Students assessed their current daily fruit and vegetable intake and set a goal and signed an oath to choose more fruits and vegetables for good health. Students recorded their fruit and vegetable intake for one week.

Implementation Measures

Quality Control and Assurance of Intervention Procedures. Direct observations were used to assure that the cafeteria environment and nutrition education intervention components were completed as planned. The PI completed at least one observation of the school cafeteria each week of the intervention. During these observations the PI assessed if intervention components were implemented as planned. For example, a survey of the cafeteria environment at the conclusion of the study assessed the presence of nutrition

messages and healthy food choices compared to control schools. Primary implementers observed all six educational dinners and three classroom education lessons.

Student Awareness of Interventions and Personal Behavior Changes. A survey, the "Effective School Intervention Survey" (ESIS, see Appendix D), was designed for students to give their perceptions regarding increases in fruit, vegetable, and dairy product intake and interventions that helped them make healthy choices. The ESIS was administered at the conclusion of the program with participants at intervention schools only. This survey was assessed for content validity and readability. The content and reading level was appropriate to gather perceptions of seventh grade students. The ESIS consisted of two parts. The first part addressed changes in fruit and vegetable consumption. The second part addressed changes in dairy product consumption. Students were asked four questions in each part: 1) "Do you eat more fruits and vegetables/dairy products now than you did at the beginning of the school year?", 2) If so, "what do you eat more of now?", 3) "Circle the activities (intervention components) that helped you eat more fruits and vegetables/dairy products", and 4) "Did anything else help you eat more fruits and vegetables/dairy products?". Questions #2 and #4 were open ended. Question #3 listed the *HEROS* intervention components.

Reach of the Program into the Population. The reach of the program into the school and family systems was estimated by quantifying the number of students, school staff, and family members who were reached by each component of the intervention.

Barriers Encountered and/or Overcome. The primary implementers provided information regarding barriers that were encountered throughout the program, how these

barriers impacted the ease/difficulty of implementing the intervention, and how barriers were overcome when possible.

RESULTS

Quality Control and Assurance of Intervention Procedures. Direct observations indicated that intervention components were implemented as planned, with two exceptions. First, the availability of fruits, vegetables, and dairy products were not increased on a la carte lines and food carts in the eating area as planned. Second, two raffles were planned, one for fruits and vegetables and one for milk. The second raffle promoting milk was not completed at any of the intervention schools. Surveys of the cafeteria environments indicated that nutrition education was ample throughout the cafeteria eating area and food line. However, the location of posters varied among schools, because the layout of each cafeteria was different. Posters were mounted every 30-40 feet of wall space. In schools with less wall space additional posters were hung from the ceiling (i.e., "danglers") and decals were put on the windows. Observations of dinner events and classroom lessons indicated that components were completed as planned.

Student Awareness of Interventions and Personal Behavior Changes. The ESIS completed by intervention participants at the conclusion of the project provided insight to the perceptions of the participants regarding their changes in fruit, vegetable, and dairy product consumption as well as the interventions that contributed to their changes. Valid data were available for 108 fruit and vegetable surveys and 104 dairy product surveys.

Approximately 65% and 56% of participants reported that they ate more fruits and vegetables and dairy products, respectively, at the end of year compared to at the beginning of the school year. The most frequently reported fruits (and percent reporting) were apples (26%), bananas (20%), oranges (16%), and grapes (12%). The most frequently reported vegetables (and percent reporting) were beans (19%), greens (13%), carrots (11%), and broccoli (10%). The most frequently reported dairy products (and percent reporting) were milk (47%), yogurt (25%), and cheese (15%).

Participants reported which intervention components were effective in helping them increase their intake of fruits, vegetables, and dairy products. The frequencies of intervention components reported by participants are listed in Figures 5.2 and 5.3. There were eight intervention components promoting fruits and vegetables and seven promoting dairy products. Of the components promoting fruit and vegetable consumption (and percent reporting) the *5 A Day Challenge* activity (27%), increasing the availability of fruits and vegetables in the cafeteria (26%), and the science class lesson (18%) were reported most often. Of the intervention components promoting dairy product consumption, the components that were reported most often (and percent reporting) were more cold milk in the cafeteria (29%), tasting-testing milk (20%), and the science class lesson (16%). The least reported intervention components were the PTA evening events and nutrition education mailed to parents for both the fruit and vegetable and dairy product questions.

Reach of the Program into the Population. For each of the intervention components completed, the reach of the materials into the school and family systems was estimated.

The cafeteria food intervention components (e.g., nutrition messages, new fruit and vegetable recipes, new milk coolers, and increased availability of fruits, vegetables, and dairy products) reached the entire population of each school, totaling approximately 2,625 students and 150 school staff (e.g., teachers, administrators, and cafeteria staff). Taste-testing and giveaway activities were not quantified, because participation was voluntary and not all students participated. The nutrition education delivered by presentations at dinners reached approximately 620 students, families, and school staff. The three pamphlets were mailed to approximately 2,625 families and distributed to approximately 150 school staff. The nutrition education delivered directly to seventh grade students reached approximately 715 students on three occasions (e.g., cafeteria pre-activity, science class lesson, and follow-up *5 A Day Challenge*). Of these students, 301 (42.1%) returned their *5 A Day Challenge* activity sheet.

Barriers Encountered and/or Overcome. Barriers encountered included time and resource constraints, which made some components more difficult to implement than others. Components requiring more time or implemented outside the structured school day were more difficult to implement. For example, dinner events required school staff to be present for extended hours and participants had to be encouraged to attend. This component was more difficult than implementing the education delivered through science classes, because the students and teachers were already at school. These barriers were overcome by encouraging participation by providing free dinners and prizes, advertising the events, and coupling the events to other activities. Barriers to implementing cafeteria interventions included lack of time to train cafeteria staff and lack of staff to implement

interventions. For example, cafeteria staff were asked to distribute raffle tickets to students on two occasions (one for fruits and vegetables and one for milk). However, staff found this task too difficult and the second raffle was cancelled. When staff was limited, a la carte lines and food carts in the eating areas were shut down. This made it difficult to promote fruits, vegetables, and dairy products in the eating area where they could compete with less healthy choices. Barriers from limited staff resources and training were difficult to overcome. Encouragement from the primary implementers motivated cafeteria staff to implement interventions through a la cart lines and food carts whenever possible.

DISCUSSION

The main purpose of this paper was to describe the development and implementation of the *HEROS* intervention, a theory-based, multi-level intervention to increase fruit, vegetable, and dairy product intake among seventh grade students. Several studies have implemented interventions to increase fruit and vegetable consumption among adolescents;[11-13, 19] however, the *HEROS* intervention is the first to address dairy product consumption as well. The prevalence of high-sugar, high-fat, and high-calorie snacks and soft drinks in middle schools,[5, 6] warrants development of school-based interventions, like *HEROS*, to increase the consumption of healthy alternatives.[16]

Conceptual models provide the constructs to understand how interventions can impact behavior.[20] A conceptual model was developed to guide the design of the *HEROS* intervention. Developing the intervention from this model utilized the strengths of several theories and built on the prior use of these theories by previous intervention studies. For

example, TEENS,[11] Gimme 5[13] and Planet Health[12] used the Social Cognitive Theory and the Healthy Youth Places Project[21] used an "ecologically informed Social Cognitive Theory" to design school-based interventions to increase fruit and vegetable consumption among adolescents. Gimme 5[13] and Clueless in the Mall,[19] which sought to increase fruit and vegetable and calcium intake, respectively, used social marketing to address the self-interests of adolescents in their interventions.

Following the lead of others, the *HEROS* intervention included multi-level components, environmental and educational components, delivered to students and to families and school employees. Environmental components focused on food availability. Educational components focused on knowledge, attitudes, and behaviors. Educational components included student self-assessment, goal setting, and taste-testing activities. Other interventions have also identified these components as primary influences on behavior changes.[11-13, 19] Food availability components were included in the TEENS[11] and Gimme 5[13] interventions and were mentioned in the Clueless in the Mall conceptual model, but not included as a tested component.[19] Knowledge, attitudes, and behaviors have been addressed through classroom nutrition education in almost all previous studies of this type.[11-13, 19] Of classroom interventions, TEENS[11] and Planet Health[12] included student self-assessment and goal setting activities, which are emphasized in the literature to be effective in promoting behavior changes.[22] Taste-testings (demonstrating the target behavior) were also common behavior change activities.[11, 13, 19] Finally, interpersonal characteristics have been addressed through family dinners at schools and educational materials sent to families in the TEENS and Gimme 5 interventions. Collectively, these

components are the current *best practices* for designing school-based nutrition interventions for adolescents.[9] Future studies are needed to further build on these techniques and develop new intervention components that can lead to healthy eating behavior changes.

Although the *HEROS* intervention used *best practices*, the intervention design had limitations. For example, the intervention was intended to impact dairy product intake. However, milk was the primary dairy product promoted. Promoting other dairy products such as yogurt or cheese with the attention that was given to milk would strengthen the impact of the intervention. The food availability components promoted milk by increasing variety and selling milk from attractive coolers, but other dairy products were not targeted in this way. The *HEROS* intervention completed a student self-assessment and goal setting activity for fruits and vegetables (e.g., *5 A Day Challenge*), but did not complete a similar activity for dairy products. This may limit the impact of the intervention to increase dairy product intake, because research supports that self-assessment and goal setting are important activities for changing behaviors.[22]

The structure of the intervention design also had limitations. The *HEROS* intervention only lasted 23 weeks. Other multi-level interventions have lasted at least two years.[11-13] This is a limitation if the short duration of the intervention is inadequate in influencing behaviors. The *HEROS* intervention components were also not implemented incrementally among schools. Thus, it is difficult to understand the contribution of each component to changes in fruit, vegetable, and dairy product intake. The TEENS Study used incremental exposure and was able to determine the components that were most

effective.[11] Resources to implement the *HEROS* intervention were limited. Additional funding to provide adequate personnel resources for cafeterias would have ensured that food availability interventions were implemented as planned. Lastly, the intervention was implemented in a small number of schools and the *HEROS* staff was responsible for implementing most of the intervention components. These two factors limit the ability to assess the impact of extending the intervention into larger numbers of schools and the feasibility of school personnel to implement the intervention.

This article also described observations of interventions, student surveys, and reports from primary implementers. Direct observations of the *HEROS* intervention identified components that were not implemented as planned. This information is important to account for when assessing the impact of the intervention on outcome measures. Other studies using direct observations to monitor intervention implementation have made similar reports.[16] Direct observations are valid measures of quality control, because they do not rely on reports from school staff, which may be a burden for schools and be less reliable.[13]

A survey was used to gather perceptions of students regarding the intervention components and their changes in fruit, vegetable, and dairy product intake. However, these data are not measures of dietary intake. Rather, they likely reflect student food preferences and student awareness of intervention components. Students reported eating several fruits, vegetables, and dairy products more often at the conclusion of the program compared to earlier in the school year. These foods were available in the cafeteria. Increasing variety may have provided more foods daily that students preferred.

High percentages of participants reported that they increased their intake of fruits and vegetables (65%) and dairy products (56%). Although this is not a direct measure of behavior change, it is a marker for cognitive stages of behavior change, because students who perceive that they eat more fruit, vegetables, and dairy products are likely to actually do so.[23] We did not assess stages of change. Cognitive change measures may be particularly valuable for other programs that, like *HEROS*, span a short time period, because cognitions are impacted before actual behavior changes are measurable.[24]

Of the *HEROS* intervention components, the *5 A Day Challenge* activity, increasing the availability of fruits, vegetables, and milk in the cafeteria, taste-testings, and the science class lesson were reported most often by students to help them make healthier choices. Gaining a better understanding of how students perceive intervention components is important in assessing the an effective design of an intervention, because successful interventions are designed considering the preferences of the target group.[16] The activities that students recalled were those that were designed to impact intrapersonal characteristics (e.g., *5 A Day Challenge*, class lesson, and taste-testing milk) and those that were designed to change the eating environment (e.g., increase the availability and appeal of fruits, vegetables, and milk in the cafeteria). Thus, using social marketing to design these components was successful in grasping the attention of participants. Interventions that use social marketing techniques will address the desires of adolescents and will be more effective in impacting the behaviors of adolescents.[15]

The reach of the materials into the school and family systems were also estimated. Despite the short duration of the intervention, substantial numbers of individuals were

targeted. Using one-on-one, group, and distant (e.g., mailing) nutrition education techniques greatly increased the potential for *HEROS* messages to reach students, families, and school staff.

The procedures used to assess the design and implementation of the *HEROS* intervention had limitations. Although the intervention was designed to impact knowledge and attitudes, these characteristics were not assessed for change from pre- to post-intervention. Understanding changes in knowledge and attitudes would facilitate understanding how intervention components lead to changes in fruit, vegetable, and dairy product intake. The ESIS was used to gather perceptions of intervention participants following the intervention. These perceptions were not measured pre-intervention or among control participants. Only half of the intervention participants completed these surveys. Thus, these data are limited in explaining intervention effects.

Although interventions targeted adolescent eating behaviors, components also targeted families and school staff. The reach of the family nutrition education was estimated (e.g., approximately 105 participants per event); however, the number of family members who participated in the dinner events or were receptive to the information mailed to homes was not quantified. Thus, the effectiveness of these components is unknown. Future research is needed to understand the impact of special school events and mailing nutrition educational information to families on student behaviors.

IMPLICATIONS

There is a great need for public health interventions to improve eating behaviors of Americans. In response to this need, school-based interventions are blossoming as important solutions to diet-related health disparities. However, as these interventions are implemented and results are reported, researchers are left with many questions regarding how they worked or did not work. Developing interventions based on behavior theories has greatly strengthened research designs. However, adequate description and assessment of the implemented intervention is an important step in the forward movement of understanding school-based health interventions. Future programs should utilize the strengths of previous studies and learn from the inadequacies of studies as well, including adequate description of the intervention design, linking theory to behavior.

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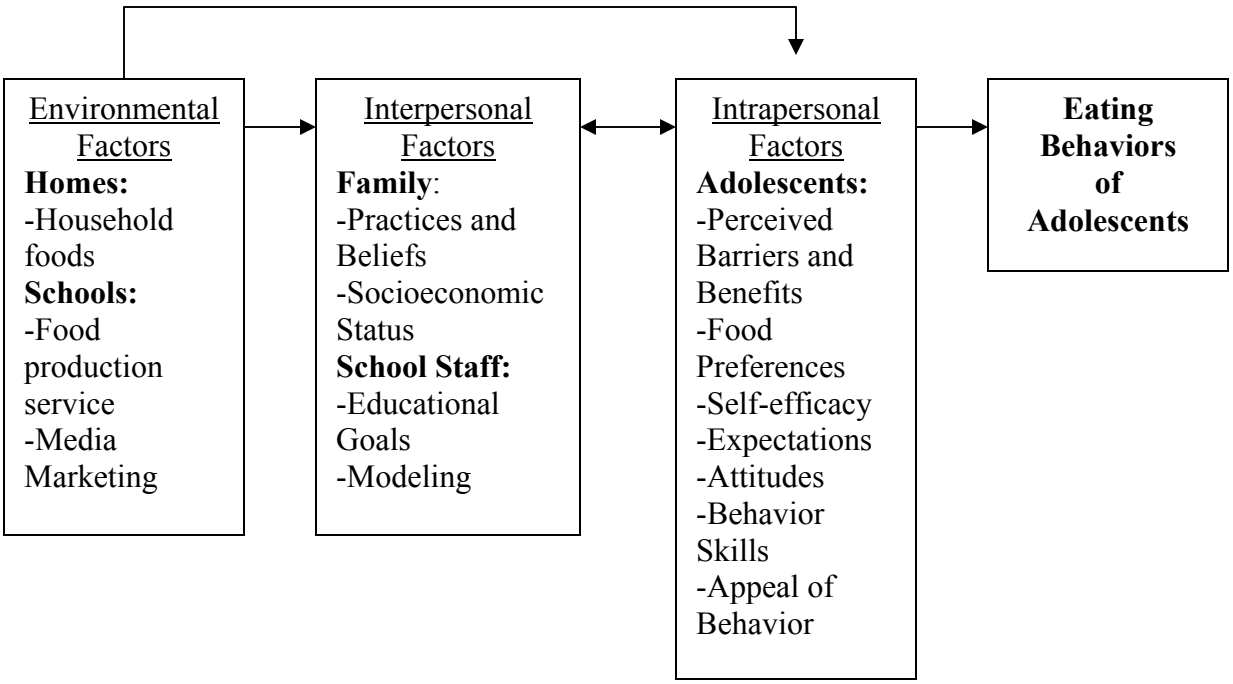

Figure 5.1. Conceptual model. A conceptual model was developed to identify environmental, interpersonal, and intrapersonal factors that directly or indirectly (as indicated by arrows) influence the eating behaviors of adolescents. These three categories of factors include specific influences (listed in the appropriate box), which are targets of school-based interventions to impact the eating behaviors of adolescents.

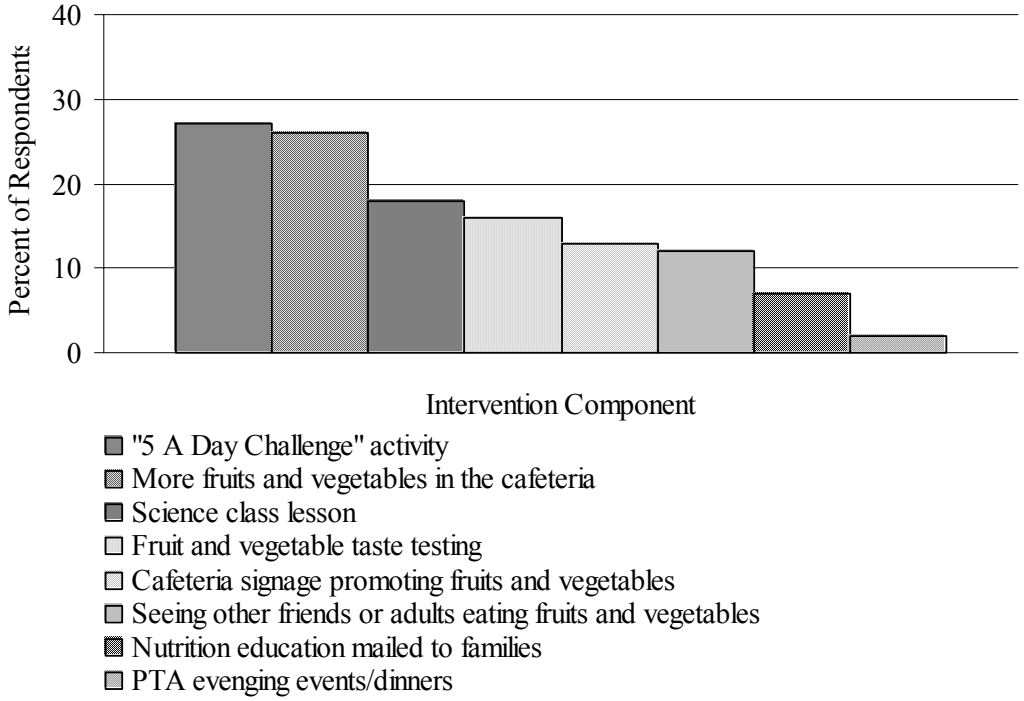

Figure 5.2. Percent of respondents reporting the intervention components that helped them eat more fruits and vegetables as reported on the on the "Effective School Intervention Survey." Participants (n = 108) who indicated they ate more fruits and vegetables at the end of the school year compared to at the beginning of the school year were asked to circle the intervention components that helped them eat more fruits and vegetables.

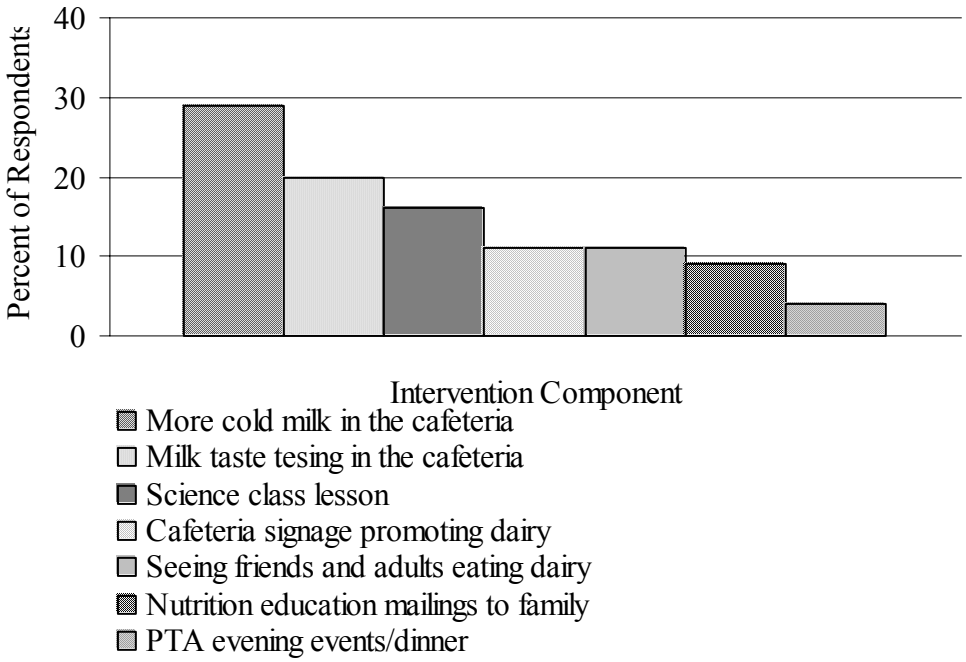

Figure 5.3. Percent of respondents reporting the intervention components that helped them eat more dairy products as reported on the on the "Effective School Intervention Survey." Participants (n = 104) who indicated they ate more dairy products at the end of the school year compared to at the beginning of the school year were asked to circle the intervention components that helped them eat more dairy.

CHAPTER VI

A FOOD DIARY TOOL FOR ASSESSING FOOD INTAKE OF ADOLESCENTS AT SCHOOL

This chapter was prepared for submission to the *Journal of the American Dietetic Association*.

ABSTRACT

Objective. To describe (in two phases) the development and preliminary validation (Phase I) and use of a school food diary tool (Phase II), the O'Connell School Food Diary (OSFD), for measuring food intake among adolescents.

Design. In Phase I, observations of school lunch intake were compared to intake recorded by students on the OSFD. Face and content validity was assessed. In Phase II, the OSFD was administered to participants in the *Healthy Eating to Reduce Obesity through Schools (HEROS) Study,* a nutrition intervention conducted in Guilford County schools in North Carolina.

Subjects/Setting. In Phase I, 35 middle school students participated in the preliminary validation of the OSFD tool. In Phase II, 489 seventh grade students participated in administration of the OSFD through the *HEROS Study*. The Youth/Adolescent Food Frequency Questionnaire (YAQ) was also administered to students.

Statistical Analyses. Baseline dietary intakes were analyzed. Validity of OSFD estimates of fruit, vegetable, and dairy product intake were evaluated through comparisons to the YAQ including descriptive statistics and correlations. OSFD records were cross-referenced to food purchase data for accuracy of recording foods by venues (e.g., food from the food line, vending machines/food carts, friends, and home) using analysis of variance and Chi-square analysis. Significance differences were identified at $p \leq 0.05$.

Results. Observations indicated 91.4% of participants reported dietary intake on the OSFD without making errors. Statistical comparisons of the OSFD to the YAQ and food

purchase data supports that OSFD estimates of fruit, vegetable, and dairy product intake are valid. Almost all participants (90-95%) accurately recorded foods by venues.

Conclusions. The design of the OSFD provides valuable detail regarding the eating behaviors of students in the cafeteria environment. However, research is needed to further investigate the validity and reliability of the OSFD tool to assess dietary intake.

INTRODUCTION

Diet is an important contributor to health outcomes.[1, 2] The diets of school-aged youth are generally high in sugar, fat, and calories[3, 4] and low in nutrient-dense foods.[5-7] It is important that programs are designed and tested to improve dietary intake and health outcomes among youth. To conduct such nutrition research, dietary intake must be accurately measured among children. This is a challenge because dietary assessment methods are often time consuming, expensive, require parent or child recalls of dietary intake, and/or are not specific to particular eating behaviors or dietary components.[8]

Studies measuring dietary intake among youth are often conducted in school settings.[9-19] The methods used in school-based research include food recalls, food records/diaries, food frequency questionnaires, and direct observations of food intake.[8] The method chosen for a study depends on the type of dietary information needed as well as the ease and cost of making assessments. Each method has limitations that must be considered when choosing a tool.

Despite the importance of and the multiple methods used to measure dietary intake among school-aged children, better tools are needed.[8] There is an increasing prevalence of nutrition intervention studies targeting foods in schools. Methods are needed that are easy and affordable to administer in the school setting. Such studies require methods that can capture changes in the consumption of specific foods like those sold through and those that compete with the National School Lunch Program (NSLP).

Of the currently available methods, 24-h recalls and direct observations are costly and too time consuming to complete in large groups in a short time period. FFQs are quick

and generally less expensive, but measure overall usual dietary intake. FFQs provide limited data for interventions that target foods eaten at school, because the impact of the intervention may not be detected when measurements include foods eaten away from school as well. Food records/diaries have been successful in assessing intake at school; however, methods used have been time consuming for both participants and researchers. To assist the establishment of new dietary assessment methodologies, the purpose of this article is to describe a school food diary tool, the O'Connell School Food Diary (OSFD, Figure 6.1, Appendix E) for measuring food intake among seventh grade students while at school. The OSFD is described in two phases: 1) development and validation of the OSFD, and 2) use of the OSFD in a nutrition intervention study.

PHASE I. DEVELOPMENT AND VALIDATION

METHODS

The OSFD was developed as part of the study *Healthy Eating to Reduce Obesity through Schools* (*HEROS*) to measure the impact of an intervention on fruit, vegetable, and dairy product intake at school. To meet the needs of this study a dietary assessment tool was needed that: 1) was inexpensive, 2) detected relatively small changes in food intake by students at school, 3) provided information about foods chosen from different school venues, and 4) could be self-administered by seventh grade students with little assistance.

Design. The OSFD was designed using concepts from the United States Department of Agriculture's (USDA) five-step multi-pass method for dietary recall.[23] Important characteristics of this method include the time of day, serving size, amount eaten,

frequently forgotten foods, and location when eating. The OSFD also was designed to utilized several characteristics of school food service to detail student intake.

School cafeterias have different venues through which foods are provided such as the main food line and vending machines.[24] The OSFD identified the venues from which foods were acquired so that the impact of food availability from different venues could be assessed.

Validation. A prototype of the OSFD was pilot tested by comparing observations of students' lunch intake to students' recorded intake on the prototype. Middle school students (N=35) in Guilford County Schools (GCS) in North Carolina of varying ethnicity and gender were selected. Students were told that researchers were "trying to see if a new activity sheet would work to learn about foods that students eat." Students were given oral directions to "write down the foods and drinks you have for lunch in the right categories and tell us how many and how much you had." Students were given a free pen for completing the OSFD prototype. Three trained researchers observed students (one researcher per student) eating their lunch from afar and made notes of what and how much was eaten. When the student completed their lunch discrepancies between the observed foods eaten and what was recorded were identified by item and amount eaten by trained researchers.

Face validity was assessed by asking for insight from students (n = 35), teachers (n = 4), and administrators (n = 2). They were asked how the tool could be improved, and how to ensure that students would complete and return the activity. Content validity was assessed by evaluation by a researcher working outside the *HEROS Study*. Content

validity also included assessing the tool for reading level. The Fry Readability Graph[25] and SMOG[26] readability tests were used to indicate the minimum reading age and grade level of the OSFD.

RESULTS

Validation. Discrepancies between the foods observed to be eaten and those recorded were found for 8.6% of the pilot test participants. Discrepancies occurred when students gave inadequate detail such as writing turkey instead of turkey sandwich. Comments from students regarding tool content and style revealed that students needed separate pages for breakfast and lunch and often could not identify the portion size of beverages. One student found that checking boxes for "how much?" was confusing.

Principals commented that students should be provided writing utensils and may have difficulty finding time during lunch to complete the form. Teachers suggested that the form should be handed out through Health or Physical Education (PE) class as a required assignment or for bonus points. Teachers also suggested that transparencies with directions should be provided to teachers to show the students how to use the form. Teachers were confident that students could complete the form well if they had written directions.

The Fry Readability Graph indicated that the OSFD was at the reading level of an eight year old. The SMOG readability formula indicated that the OSFD was at the fifth grade level. Both of these tests indicate that the OSFD is at an appropriate reading level to be administered to seventh grade participants.

Redesign of the OSFD. Based on the pilot test and the comments from students, administrators and teachers, alterations were made to the prototype and the final version of the OSFD was used in the *HEROS Study*. A separate page was included for breakfast for each day. The purpose of this page was to prevent students from listing breakfast foods as lunch foods. Icons were added to help explain the different sections for food location (e.g., foods from the food line, vending machines/food carts, friends, and home).

Samples were provided on the last page with pictures and portion sizes of beverages. This sample also emphasized that students should include *how many* and *how much* they ate. Spaces asking for different types of information (e.g., type of food, serving size, amount eaten) were separated using lines and boxes. This design guided students to mark in these spaces. A blank space was left for students to make notes about their meals, but did not request any specific information. Simple directions were listed on the front of the OSFD. The redesign of the OSFD did not change the readability of the instrument. The resulting OSFD was a six page, 8 1/2" by 11" booklet that was printed, front and back, in black and white that assessed foods consumed at school for five consecutive school days.

PHASE II. ADMINISTRATION AND ANALYSIS

METHODS

Administration of the OSFD. The OSFD was administered throughout the *HEROS Study* as an assignment for seventh grade PE classes. For this reason, all seventh grade students were instructed to complete the forms, not just participants. The cafeteria

managers at each school were given a disposable camera and asked to write down what was provided for breakfast and photograph the lunch line each day during the week that the OSFDs were administered. The purpose of the photographs was to provide picture documentation of foods available to assist in interpreting the responses of students.

Table toppers with instructions and pencils were provided in the cafeteria. Transparencies and sample booklets were provided for seventh grade teachers to instruct students on how to complete the OSFD. Handouts and letters for school staff were also developed to help instruct all school staff on the purpose and the methods for completing these forms.

OSFD Analyses. OSFDs were analyzed for participants who provided at least three of the five days of data. Analyses were completed for lunch meals. The OSFDs were analyzed for the number of servings of fruits, vegetables, and dairy products consumed.

Recipes from GCS were analyzed to create a food group database. For items not prepared by GCS, the nutritional information was acquired from the manufacturer. In the occurrence that nutritional information was not available, a generic food item was used. Food group data were generated using Diet Analysis Plus software (version 5.1, ESHA Research 2002) and the guidelines set by the Food Guide Pyramid.[27] Possible responses to amounts eaten were *all of it, most of it, few bites/sips* and *none* and were recorded as 1, 0.66, 0.33, and 0 servings of an item.

Other Dietary Assessments. OSFD estimates of fruit, vegetable, and dairy product intakes were compared to two other assessment methods that were used by the *HEROS Study*, the YAQ and cafeteria purchase data, which were collected for the same

participants. The purpose of these comparisons was to investigate the validity of dietary intakes estimated by the OSFD. The YAQ estimated usual daily intake over the past month for the same variables as the OSFD. Data were retrieved for foods purchased from the cafeteria food line. Purchase data indicated whether students purchased NSLP meals and a la carte items. The purchase data did not indicate what foods were chosen to complete the NSLP meal or if foods were purchased from other venues such as from vending machines.

Statistical Analyses. Cross-sectional data from baseline assessments of dietary intake were analyzed. OSFD estimates of food group intake were compared to the YAQ and cafeteria purchase data. The YAQ estimated usual daily intake over the past month for the same food groups estimated by the OSFD. Thus, the rationale for these comparisons was that daily intakes estimated by the YAQ should be greater than lunch intakes estimated by the OSFD. The relationship between reported intakes of fruits, vegetables, and dairy products on the YAQ and the OSFD were analyzed by evaluating mean intakes and difference scores. A difference score was calculated for servings of fruits, vegetables, and dairy products by subtracting the OSFD values from the YAQ values. Cumulative distribution frequency (CDF) graphs of the difference scores were evaluated to determine if mean values were positive (e.g., YAQ values were > OSFD values). The OSFD values for servings of fruits, vegetables, and dairy products were correlated to those from the YAQ. Correlations were evaluated for significance ($p < 0.05$) and positive or negative associations. Positive correlations would indicate valid estimates by the OSFD.

Data were retrieved for foods purchased from the cafeteria food line, including the number of NSLP meals purchased. The fruits, vegetables, and dairy products available at schools were components of the NSLP and few were purchased as a la carte items. Thus, the rationale for comparing the OSFD to food purchases was that students purchasing NSLP meals should have consumed more fruits, vegetables, and dairy products than those who did not purchase NSLP meals. Analysis of variance (ANOVA) was used to test for significant differences in intakes of fruits, vegetables, and dairy products between students who purchased a NSLP meal at least once and those who did not.

Chi square analysis was completed to demonstrate that participants correctly reported the venue from which they acquired their foods (e.g., foods from food line, vending machines/food carts, friends, and home). Two subgroups were compared: 1) students who reported eating foods (or not eating foods) from the food line on the OSFD and 2) students who purchased a NSLP meal (or did not purchase a NSLP meal). Significant ($p < 0.05$) proportions of participants falling in the same category, yes (or no), for both subgroups would indicate that foods were recorded in the correct venues on the OSFD.

RESULTS

Administration. Of the approximate 2,625 seventh grade students at the six participating middle schools, 895 (34.1%) turned in the OSFD to their PE teacher. Approximately, 71% of study participants completed the OSFD at baseline.

YAQ and OSFD Analyses. Mean intakes of fruits, vegetables, and dairy products for the YAQ were greater than for the OSFD. Mean intakes of fruits, vegetables, and dairy products for the YAQ/OSFD were 1.86/0.39, 1.68/0.20, 3.23/0.74 servings per day, respectively. CDF graphs of the difference scores indicated that values were primarily positive (e.g., YAQ values were greater than OSFD values), with the majority of values falling between zero and five servings per day. The correlation of OSFD to YAQ values was positive and statistically significant for fruits ($p = 0.003$, $r = 0.18$) (Figure 6.2) and dairy products ($p = 0.003$, $r = 0.13$) (Figure 6.3). Data for vegetable intake clustered close to zero for both measures and the correlation of OSFD to YAQ values was not significant ($p = 0.13$, $r = 0.09$).

Food Purchases and OSFD Analysis. ANOVA indicated significantly higher intakes of fruits, vegetables, and dairy products for individuals purchasing a NSLP meal at least one day of the week compared to students who did not purchase a NSLP meal. Mean servings for those purchasing/not purchasing NSLP meals (p-value) were 0.43/0.33 ($p = 0.055$), 0.24/0.10 ($p < 0.001$), and 0.89/0.36 ($p < 0.001$) for fruits, vegetables, and dairy products, respectively.

Chi square analysis was significant for those who recorded foods from the *food line* and purchased NSLP meals, with 90% ($p < 0.001$) agreement. Chi square analysis was also significant for participants who did not record foods from the *food line* and did not purchase NSLP meals, with 95% ($p < 0.001$) agreement.

DISCUSSION

The OSFD meets several needs of school-based nutrition research. Unlike 24-h recalls,[8] observations,[8] and prior food record/diary methods,[11, 28, 29] the OSFD is easy and affordable to administer to large numbers of students in a short time period. It provides specific detail that is not provided by FFQs. Thus, the OSFD is ideal for use in school intervention programs. The OSFD method may be more accurate than recalls and FFQs, because it does not rely on memory.[8] During Phase I almost all participants were able to complete the OSFD with ease and accuracy. The OSFD quickly guides students through a meal record and may be less of a burden than standard food record methods.[8] The ease with which the OSFD can be completed may decrease underreporting, which is a problem with most assessment methods.[8, 22, 29]

The structure of the OSFD form included several components that have been used by prior research. Like the OSFD, a food record form used in the Gimme 5 program included written instructions and sample pages.[28] Both forms included cues for meals (e.g., breakfast vs. lunch), separate columns for foods and drinks, and check boxes for the amount eaten. However, the designs differed in that the Gimme 5 record form did not specify information about different food venues within school cafeterias and the OSFD did. The Gimme 5 method used extensive teacher/student training and reinforcement during administration by study personnel.[11, 28, 29] Contrary to this method, the OSFD was less time consuming. The discrepancies between these assessment methods may be attributed to designs for different age groups. The Gimme 5 method was designed for

elementary school students, where as the OSFD method was designed for middle school students.

Several studies have indicated that the high prevalence of unhealthy foods served via a la carte and in vending machines negatively impacts student food intake.[24, 30-34] The OSFD allows students to record foods obtained from the food line, vending machines, friends, or home. Thus, the influences of food venues on dietary intake can be investigated. The impact of interventions that target foods acquired through one or more of these venues may be better detected by assessing student intake specific to foods chosen at school from different venues.

Observations of student intake from the pilot test indicated that almost all students were able to record their lunch accurately. Investigation of face and content validity provided relevant insight that improved the tool and allowed administration to be successful. For example, completing the OSFD as an assignment may have decreased the impact of motivation on return of the OSFD by participants. Students and school staff accepted the tool, with more than one-third (34.1%) of seventh grade students returning the OSFD.

Several statistical comparisons were made between the OSFD and the YAQ and food purchase data. These comparisons suggest that the OSFD provides valid estimates for lunch intake of fruits, vegetables, and dairy products. Chi square analysis demonstrated that participants recorded foods in the correct venue (e.g., from *food line*, *vending machines/food carts, friends*, and *home*). This is important, because once the impact of these venues on food choice behaviors are elucidated, policies and procedures

can be developed that maximize the effect of different food choice venues to promote healthy eating behaviors at school.

The validation techniques reported have several limitations. One must consider that the YAQ and OSFD estimated dietary intake through different means. The YAQ estimated food intake over a long period of time (e.g., one month), whereas, the OSFD estimated more specific information about food choices over a short period of time (e.g., five school days). The YAQ included weekend days and the OSFD did not. This is important, because the food choices of adolescents differ between school days and weekend days.[35] The OSFD was also compared to food purchase data, which has been used as a marker,[36] but is not a direct measure of actual food intake. Food sharing and waste accounts for discrepancies between foods documented to be purchased and foods reported to be consumed.

The validation techniques reported in this article are only the initial steps in validating the OSFD method. A more thorough, quantitative validation is needed before the value of the OSFD for estimating student intake is more clear. Such validation should follow the lead of others and use blind observations analyzed for nutrient and food group content.[37, 38] Interobserver reliability should also be measured and reported.[39]

CONCLUSIONS/ APPLICATIONS

- Schools have ample opportunity to positively and negatively influence food choices of students. Research is needed to assess the impact of food availability and nutrition education on eating behaviors.

- The development and use of the OSFD is a starting point for future research to gather specific data on the eating habits of students while in the school environment. Further research is needed to evaluate the validity of the OSFD method.
- Other researchers should build on the concepts used to design the OSFD to develop and validate assessment methods to investigate the influence of schools on eating behaviors of youth.

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PE Assignment

THE UNIVERSITY OF NORTH CAROLINA GREENSBORO Kellie O'Connell Developed by & property of H.E.R.O. Schools Study

Breakfast: Monday

First Name: **Last Name:** **Lunch #:**

I ate Breakfast at SCHOOL:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

I ate Breakfast at HOME:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

NOTES:

Figure 6.1 Sample pages of the O'Connell School Food Diary

PE Assignment

THE UNIVERSITY OF NORTH CAROLINA GREENSBORO

Kellie O'Connell Developed by & property of H.E.R.O. Schools Study

Lunch: Monday

First Name: **Last Name:** **Lunch #:**

What I ate from the Food Line:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

What I ate from Vending Machines or Food Carts:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

What I ate from my Friends:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

I Brought My Lunch and I ate:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

Return this form to your PE teacher for credit!

Figure 6.1 (continued)

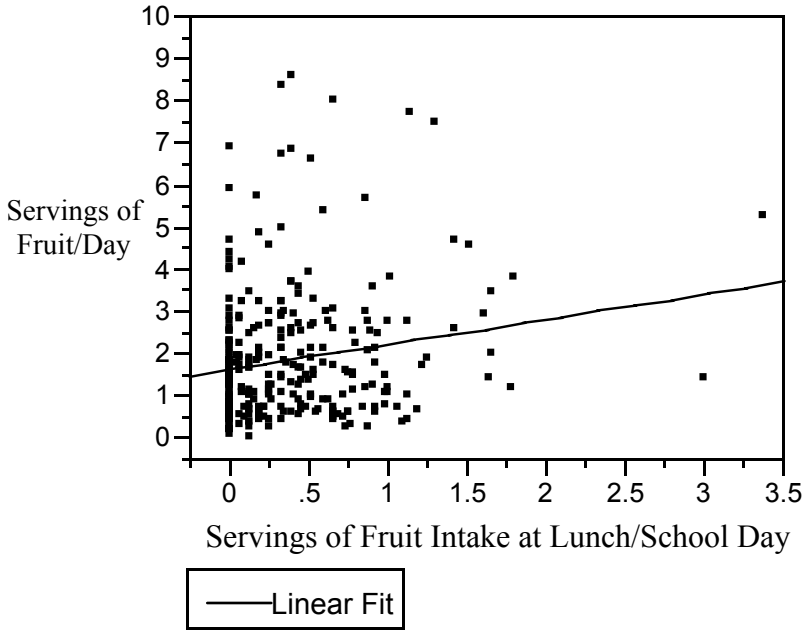

Figure 6.2. The correlation between YAQ£ and OSFD¥ measures of fruit intake at baseline.

Linear Fit Equation, p = 0.003, r = 0.18: Y = 1.6220775 + 0.5966094 (X)

Y = Baseline servings of fruit per day

X = Baseline servings of fruit eaten at lunch at school

£ Youth and Adolescent Food Frequency Questionnaire, measured daily intake.

¥ O'Connell School Food Diary, measured intake at lunch per school day.

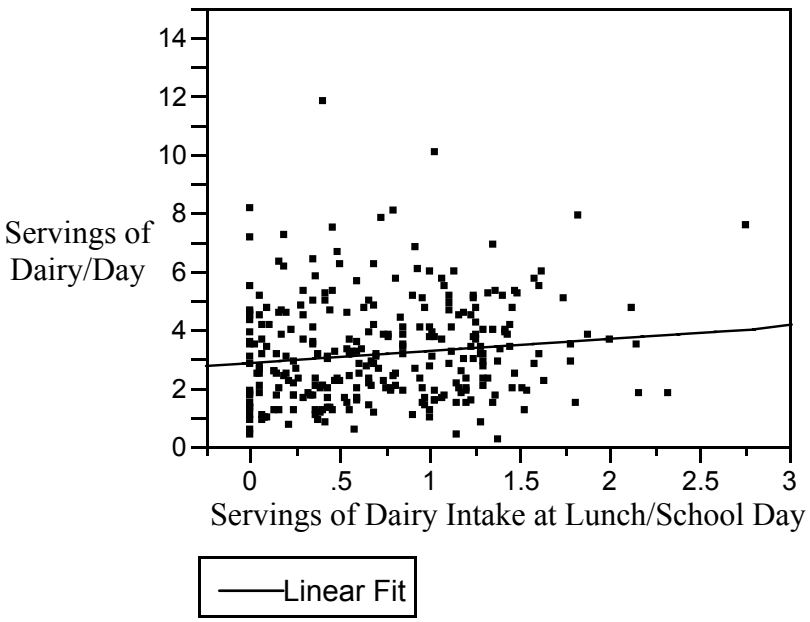

Figure 6.3. The correlation between YAQ£ and OSFD¥ measures of dairy product intake at baseline.
Linear Fit Equation, p = 0.003, r = 0.13: Y = 2.924278 + 0.4143377 (X)
Y = Baseline servings of fruit per day
X = Baseline servings of fruit eaten at lunch at school
£ Youth and Adolescent Food Frequency Questionnaire, measured daily intake.
¥ O'Connell School Food Diary, measured intake at lunch per school day.

CHAPTER VII

HEROS INTERVENTION INCREASES VEGETABLE INTAKE AMONG ADOLESCENTS

This chapter was prepared for submission to the *Journal of the American Dietetic Association*.

ABSTRACT

Objective. To determine the impact of a one-year, school-based environmental and educational intervention, *Healthy Eating to Reduce Obesity through Schools (HEROS)*, on fruit, vegetable, and dairy product consumption and overweight/obesity prevalence among adolescents.

Design. Fruit, vegetable, and dairy product consumption was estimated pre- and post-intervention, both at school lunch and throughout the entire day using a school food diary tool and the Youth/Adolescent Food Frequency Questionnaire, respectively. Body mass index and triceps skinfold thickness were measured to determine the prevalence of overweight/obesity pre- and post-intervention.

Subjects/Setting. Participants were seventh grade students (n = 489) from six middle schools (three intervention and three control) in Guilford County, NC.

Statistical Analyses. Analysis of variance and Chi-square analysis tested for significant ($P<0.05$) differences between groups at baseline. A general linear model tested for significant intervention effects on outcome variables.

Results. The intervention group significantly increased their vegetable intake at lunch by almost one fifth of a serving (0.19 ± 0.14) whereas the controls decreased their vegetable intake (-0.14 ± 0.07). African Americans in the intervention group significantly increased their daily vegetable intake by one third of a serving (0.33 ± 0.25) whereas their control counterparts decreased their vegetable intake (-0.34 ± 0.22). No significant differences

were found between groups for fruit or dairy product consumption or the prevalence of overweight/obesity.

Conclusions. The *HEROS* Study demonstrated that an environmental and educational nutrition intervention positively impacted vegetable consumption, especially among African Americans who are at high risk for many diet-related morbidities.

INTRODUCTION

The prevalence of overweight among adolescents in the U.S. has increased 3-fold in three decades.[1] Obese adolescents are at risk for type II diabetes and asthma during youth[2, 3] and heart disease, cancer, hypertension, and sleep apnea if they remain obese in adulthood.[4, 5] To support a healthy weight, diets must be nutrient-dense, but not exceed caloric needs. Nutrient-dense foods are lacking in the diets of school-aged children, especially fruits, vegetables, and dairy products.[6-8]

There is substantial evidence supporting the health benefits associated with consuming a nutrient-dense diet rich in fruits, vegetables, and dairy products.[6-8, 55] The objectives of Healthy People 2010[9] for youth include increasing the proportion of persons two years and older who consume at least two daily servings of fruit to 75% and who consume at least three daily servings of vegetables, with at least one being dark green or deep yellow to 50%. Dairy products are the primary source of calcium in the diet.[10] The objectives of Healthy People 2010 for youth also include increasing the proportion of persons two years and older who meet the dietary recommendations for calcium ($\geq$ 1300 mg/day) to 75%.[9]

U.S. youth are not meeting these objectives. Neumark Sztainer et al.[11] found that among adolescents (n = 4,746), less than 50% consumed at least two servings of fruits per day and less than 20% consumed at least three servings of vegetables per day. The percentage of girls and boys consuming 1300 mg/day of calcium were 30% and 43%, respectively. Other studies have found similar trends of low consumption of fruits, vegetables, and dairy products.[12-16]

Of the stages of youth, adolescence is a time for physical and psychosocial development.[17, 18] Thus, it is a key stage to develop behavioral patterns that are likely to be sustained into adulthood. For nutrition interventions to impact adolescents, opportunities impacting food choices are needed that mold the knowledge, attitudes, and beliefs of adolescents. Schools are particularly suited for nutrition interventions for adolescents; because they have access to 95% of the youth population in the U.S.[19] and 35-40% of daily energy intake is consumed at school.[20] Prior research has emphasized the importance of designing and testing the effectiveness of school-based nutrition interventions.[21-23]

The primary influences on eating behaviors within the school environment include food availability and nutrition education in schools.[23, 24] The National School Lunch Program (NSLP) is the primary source of fruits, vegetables, and dairy products in schools.[25-28] There is no doubt that implementation of the NSLP increases the nutrient intakes of participants.[29-33] However, the prevalent increase in obesity among school-aged children, especially among vulnerable populations eligible for free or reduced meal prices, has led researchers to investigate foods available in schools to determine factors that may contribute to poor eating behaviors. Several studies have found that students consume more than the recommended amount of calories, protein, fat, and saturated fat from foods in the NSLP.[30, 31, 33] Encouraging consumption of the fruits, vegetables, and dairy products provided through the NSLP supports healthy eating habits and thus, healthy bodies.

The NSLP does not impact the eating habits of students alone; foods are also available to students through other school venues such as vending machines,[27] which compete with NSLP school meals.[25] A survey of nationally representative schools indicated that only 12% of middle schools sold fruits and vegetables and 19.5% sold low fat milk at these same locations.[25] These studies provide support for interventions that increase the availability of fruits, vegetables, and dairy products as healthy alternatives to competitive foods.

Several research groups have developed and tested nutrition interventions for school-aged children.[34-44] However, the intervention designs and their impact on eating behaviors have varied. Therefore, the purpose of this study was to determine the impact of a one-year, school-based environmental and educational nutrition intervention, *Healthy Eating to Reduce Obesity through Schools (HEROS)*, on fruit, vegetable, and dairy product consumption and overweight and obesity prevalence among adolescents.

METHODS

Study Design and Population. The *HEROS* Study was a one-year nutrition intervention conducted in Guilford County Schools (GCS) in NC. GCS is made up of 106 schools (e.g., 64 elementary, 18 middle, and 16 high schools) and is the third largest school district in NC, with more than 65,000 students. The overall population in GCS is 46.0% White, 40.0% African American, 14.0% other (e.g., Hispanic, American Indian, Asian, and Multi-Racial), and 45.0% low income. Nine of fifteen eligible middle schools agreed to participate. Schools were eligible if they had not participated in a nutrition intervention

in the past three years. Schools were paired for predominant ethnicity and income level (e.g., high income ≤ 50% and low income ≥ 50% of students receiving free or reduced price lunches). Three pairs of schools were randomly chosen and assigned to intervention or control groups. All seventh grade students were allowed to participate if they returned their informed consent form and met the inclusion criteria (n = 489). Students were excluded if they did not speak and read English or had special education needs. Approval was received from the Institutional Review Boards of the University of North Carolina at Greensboro and GCS to conduct this study.

Intervention. The *HEROS* intervention was designed based on concepts of the Social Cognitive Theory,[45] an ecological model of health behavior,[45, 46] and social marketing.[45] The *HEROS* intervention was implemented over 23 weeks. Control schools received no intervention. The intervention promoted fruit, vegetable, and dairy product consumption. There were three components of the intervention providing: 1) nutrition education and food availability for students in the cafeteria environment; 2) nutrition education for family/school staff; and 3) nutrition education for students in the classroom. The cafeteria environment intervention introduced new fruit and vegetable recipes and promoted milk consumption using standing glass door coolers rather than traditional stainless steel bins. Taste-testing and raffle events promoted the intake of fruits, vegetables, and dairy products in the cafeteria. Nutrition education was infused into the eating area with posters and point of sales displays. Family dinners were held at the schools with educational speakers and pamphlets were mailed to parents. Classroom education entailed a nutrition lesson taught to students through their science classes. The lesson had three parts: 1) a

pre-activity to introduce the topics prior to the lesson; 2) the class lesson; and 3) a *5 A Day Challenge* follow-up activity.

Assessments. Measures were assessed at baseline and at follow-up. Athropometric measurements included height, weight, and triceps skinfold thickness (TSF). Dietary measures included fruit, vegetable, and dairy product intake at school lunch and throughout the day. Physical activity level was also estimated using one question from the Modifiable Activity Questionnaire for Adolescents (MAQA). Sociodemographic data collected included gender, birth date, ethnicity, and free or reduced NSLP certification as an indicator of socioeconomic status (SES).

Anthropometric Measures

Height was measured to the nearest 0.01 cm using a portable stadiometer. Weight was measured in light clothing to the nearest 0.01 kg on a calibrated Tanita™ BWB-800 digital scale (Brooklyn, NY). Body mass index (BMI) was calculated as kg/m^2 and BMI-for-Age percentiles were determined using the Centers for Disease Control and Prevention statistical program.[47] The primary investigator measured TSFs to the nearest 0.20 mm using a Harpenden skin fold caliper by Body Care™ (Warwickshire, U.K.). If TSF measures differed by more than 1 mm, three and sometimes four measures were taken. The average TSF was calculated and participants were identified as being above or below the 85th percentile for TSF-for-Age, using age- and gender-specific CDC growth charts.[48]

Using BMI and TSF together provides a better indicator of body weight and fatness status than using either method alone.[49] BMI- and TSF-for-Age percentiles were

used together to identify participants that were not only overweight (e.g., excess weight), but also obese (e.g., excess body fat). This method has been previously described by Gortmaker et al. (1999), validated for adolescents, and used in NHANES.[50] Participants were classified as overweight if their BMI-for-Age was $\geq 85^{th}$ percentile and obese if their BMI-for-Age and TSF-for-Age were $\geq 85^{th}$ percentile.

Dietary Intake

Dietary intake was measured using two methods to estimate intake during school lunch and overall daily intake of fruits, vegetables, and dairy products. A food diary tool, the O'Connell School Food Diary (OSFD, see Appendix E), estimated servings of fruits, vegetables, and dairy products consumed at school for one school week for all participants simultaneously. Validation of this tool to observations of lunch intake of students for one day (n = 35) showed high agreement (91.4%) for food items and amount eaten. This tool was also pilot tested for content and face validity. Students were trained to complete the food diary through their physical education classes.

The Youth/Adolescent Food Frequency Questionnaire (YAQ, see Appendix F) is a quantitative food frequency questionnaire validated for adolescents of varying ethnicities.[51] The YAQ estimated overall daily servings of fruits, vegetables, and dairy products consumed over the previous month. Approximately one trained researcher was available per ten students to assist and monitor students during administration. Fruit intake included 100% juice and vegetable intake did not include French fries for both dietary tools.

Physical Activity

Physical activity level was estimated using one question from the MAQA.[52] Participants were asked how many days they exercised vigorously for 20 minutes in the past two weeks. Responses were categorized into two groups following guidelines from the North American Society of Pediatric Exercise Medicine (NASPEM).[53] Students who exercised vigorously for 20 minutes six or more days in the past two weeks were classified as meeting the NASPEM guideline.

Statistical Analyses. Statistical analyses were completed using JMP statistical software version 5.1.1 (Cary, NC). Analysis of variance (ANOVA) and Chi-square analyses were used for continuous and categorical data, respectively, to test for significant differences between intervention and control groups at baseline for demographic characteristics, overweight and obesity prevalence, dietary intake, and physical activity level.

To test the impact of the intervention on dietary intake, change scores were calculated by subtracting follow-up from baseline servings of fruit, vegetable, and dairy products consumed both at school (by the OSFD) and daily (by the YAQ). Change scores were tested as the dependent variable in a general linear model (GLM). The GLM tested for main effects of the following independent variables: treatment, gender, SES, and ethnicity on the dependent variable. Pair-wise comparisons of least square regression means that were statistically significant were identified using student *t* tests. To test the impact of the intervention on the prevalence of overweight and obesity among

participants, Chi-square analyses were used. For all analyses (e.g., ANOVA, Chi-square, and GLM) $p \leq 0.05$ was considered statistically significant.

Baseline and follow-up anthropometric, OSFD, and YAQ data were not available for all 489 participants. No significant differences existed between baseline characteristics of intervention and control participants for the data available in these three subsets. For this reason, all data were used for analyses. The sample sizes for the anthropometric, OSFD, and YAQ data subsets were 406, 132, and 352 students, respectively.

RESULTS

Baseline Characteristics. Baseline demographic characteristics were 58.9% White, 54.9% female, and 26.7% low SES. Mean $\pm$ standard deviation (SD) baseline estimates of daily fruit, vegetable, and dairy product consumption were 2.01 $\pm$ 1.78, 1.70 $\pm$ 1.55, and 3.31 $\pm$ 1.97 servings among all participants, respectively. Mean $\pm$ SD baseline estimates of fruit, vegetable, and dairy product consumption at school lunch were 0.40 $\pm$ 0.45, 0.20 $\pm$ 0.32, and 0.74 $\pm$ 0.53 servings per day, respectively. At baseline 29.2% of participants were overweight and 19.4% were obese. No significant differences in demographic characteristics, physical activity, or dietary intake existed between intervention and control groups at baseline (Table 7.1).

Overweight and Obesity Prevalence. No significant differences were found in the prevalence of overweight and obesity among participants in the intervention and control groups from baseline to follow-up (Chi-square = 0.02, p = 0.88).

Dietary Intake. The GLM tested for main effects of the following independent variables: treatment, gender, SES, and ethnicity on change in dietary intake (the dependent variable). The GLM accounted for 16% ($p = 0.01$) of the variation in changes in school lunch intake of vegetables. There was a significant main effect for the treatment group ($p < 0.04$), with the intervention group increasing their vegetable intake at lunch by almost one fifth of a serving (0.19 ± 0.14), whereas the control group decreased their vegetable intake at school lunch by one seventh of a serving (-0.14 ± 0.07) (Figure 7.1). There was a significant interaction between the treatment group and gender with males in the intervention group increasing their vegetable intake at school lunch by more than one third of a serving (0.38 ± 0.18), whereas females in the intervention group had no change in their vegetable intake (0.00 ± 0.14) (Figure 7.2). Vegetable intakes of males in the intervention group were significantly higher than those of males (-0.12 ± 0.08) and females (-0.15 ± 0.07) in the control group who decreased their vegetable intake at school lunch.

The GLM accounted for 6% ($p = 0.02$) of the variation in changes in daily intake of vegetables. There were no significant main effects; however, a significant interaction between the treatment group and ethnicity was found ($p < 0.001$) (Figure 7.3). African Americans in the intervention group increased their daily vegetable intake by one third of a serving (0.33 ± 0.25) compared to their control counterparts who decreased their daily vegetable intake by one third of a serving (-0.34 ± 0.22).

The GLM was not significant when changes in school lunch intake of fruit ($p = 0.2389$) and dairy products ($p = 0.8855$) were the dependent variables. The GLM was

significant when changes in overall daily intakes of fruit ($p = 0.04$, $R^2 = 0.05$) were the dependent variable, but with no significant treatment effect. The GLM was not significant when changes in overall daily intakes of dairy products ($p = 0.3735$) were the dependent variable.

DISCUSSION

The *HEROS* intervention significantly increased vegetable intake among participants. Specifically, the intervention group significantly increased their vegetable intake at school lunch by one fifth of a serving compared to controls. Males in the intervention group significantly increased their vegetable intake at school lunch by more than one third of a serving (0.38 ± 0.18), compared to females in the intervention group and males and females in the control group. African Americans in the intervention group significantly increased their daily vegetable intake by one third of a serving compared to their control counterparts who decreased their daily vegetable intake by one third of a serving. These findings are novel because prior school-based nutrition interventions for adolescents have not reported significant increases in vegetable intake alone, specifically at school lunch, or among African Americans, a minority group at risk for health disparities.[55, 56]

Prior studies have reported significant impacts when fruit and vegetable intake were analyzed together. In the first year of the TEENS Study, fruit and vegetable intake significantly increased by one half and one whole serving per day, respectively, for participants exposed to an educational and environmental intervention and for those who

were also peer leaders in the intervention.[42] However, when fruit and vegetable intake were analyzed as two separate variables, the intervention had no significant impact on vegetable intake.

New Moves,[54] Planet Health,[41] and Gimme 5[43] were nutrition interventions for adolescents that only reported fruit and vegetable intake as one variable. New Moves, a one-semester intervention, had no significant impact on fruit and vegetable intake. Planet Health, a two- year intervention, increased fruit and vegetable intake by one fifth of a serving. Gimme 5, a two-year intervention, had a significant increase of one third of a serving of fruits and vegetables in the intervention group; however, this increase was not significantly different from the control group. Thus, prior studies have reported increases in fruit plus vegetable intake ranging between one fifth to one whole serving per day. In comparison, the *HEROS* intervention increased vegetable intake alone by approximately one fifth of serving, which is within the ranges reported for fruit plus vegetable intake reported in previous studies.[41, 43] The increases in vegetable intake ranged from one fifth of a serving at one meal alone (e.g., school lunch), to one third of a serving for males at school lunch and African Americans throughout the entire day. No previous intervention studies among adolescents have had similar findings for vegetable intake at school lunch or among specific gender or ethnic groups.

The *HEROS Study* measured intake in the target environment (e.g., at school lunch) using the OSFD and throughout the entire day using the YAQ. Prior school-based intervention studies for adolescents have measured only daily dietary intake using a variety of tools. Measuring dietary intake at school in addition to measuring overall daily

intake better assesses the impact of the *HEROS* intervention on changes in dietary intake. This is important because the impact of the intervention may not be detected if measurements are not specific to the desired behavior in the target environment.

It is notable that control participants decreased their intake of vegetables in the *HEROS Study*. The control group decreased their vegetable intake at school lunch by one seventh of a serving. African Americans in the control group decreased their daily vegetable intake by one third of a serving. The difference in school intake of vegetables between the intervention and control groups at the end of the study was almost one fourth of a serving. The difference between daily intake of vegetables between African Americans in the intervention and control groups at the end of the study was more than two-thirds of a serving. The reasons for decreases in vegetable intake observed among control participants are unclear. Planet Health had similar findings, with the intervention group increasing and the control group decreasing their fruit and vegetable intake by one fifth of a serving, a net difference of almost one third of a serving.[41] The Integrated Nutrition Project,[40] a nutrition intervention for elementary school students, had similar findings for daily vegetable intake as well. Decreased intake may be due to seasonal changes, because baseline measures were taken in the fall and follow-up measures were taken in the spring in our study. It is also possible that decreased intake reflects students becoming less interested in vegetable choices at school. Further research is needed to investigate the food intake of students at the beginning compared to the end of the school year to better understand why students decrease their intake of certain foods as the school year progresses.

African Americans were the only ethnic group that showed significant improvements for daily vegetable intake. The *HEROS* intervention was multi-level, targeting students, teachers, and families through both environmental and education strategies. However, the intervention was not implemented with incremental exposure to components; thus, it is not known how each component of the intervention impacted intake. In a previous study, focus groups conducted among low-income, African American women indicated that barriers such as cost, convenience, and taste preferences of their children greatly inhibited their ability to purchase and provide vegetables for their families.[55] The *HEROS* intervention promoted vegetables that were available through the NSLP. These items were affordable, conveniently available at school, and taste-tested to be acceptable to students. Using these approaches, the intervention may have increased vegetable intake by decreasing the barriers of cost, convenience, and taste preferences for vegetables. Intervention studies among low-income African Americans have been successful when decreasing barriers to the target behavior was a primary intervention component.[56, 57] Future research is needed to understand the impact of different intervention components on healthy eating habits in ethnic groups, especially those at a higher risk for health disparities.

In addition to vegetables, the *HEROS* intervention also sought to increase fruit and dairy product intake. However, no significant differences in fruit and dairy product intake were found between intervention and control groups. Intervention components were identical for fruit and vegetable intake. It is not known why vegetable intake significantly increased, but fruit intake did not. This may be the result of a threshold

effect, because fruit intake was higher than vegetable intake at baseline. Thus, students may have been more responsive to increasing their vegetable intake, because vegetables were less abundant in their diets than fruits at baseline. Also, it may require more than 23 weeks to impact fruit intake.

The lack of a significant increase in dairy product intake may have been observed for several reasons. Like fruits, the consumption of dairy products was also higher than vegetable consumption at baseline. Thus, participants may have been less responsive to increasing their dairy product compared to vegetable intake, and/or it may require a longer period of time to impact dairy product intake. The outcome measure used was dairy product intake; however, the intervention only promoted milk. Other dairy products like yogurt and cheese were not a focus of any of the intervention components. If milk instead of dairy product intake was the outcome measure, the impact of the intervention on consumption may have been better detected. Milk was sold from glass door coolers rather than the traditional stainless steel bins in an attempt to keep the milk colder and increase its appeal. This tactic may have had less impact than those used for vegetables, which utilized new recipes and more variety of whole vegetables. Vegetable intake was also promoted using a behavior-challenge activity through the class lesson (e.g., *5 A Day Challenge*). There was no behavior-challenge activity for milk intake. There are no other peer-reviewed, school-based nutrition interventions that have been tested among adolescents to increase milk or dairy product intake. Therefore, it is not possible to compare the dairy components of the *HEROS* intervention to previous research. Overall, these discrepancies between intervention strategies may have led to significant increases

in vegetable intake, but no significant increases in the consumption of dairy products or fruit. Future research is needed to elucidate how interventions can impact overall healthy eating rather than only certain components of the diet so that the overall diets of youth are improved.

The purpose of the *HEROS* intervention was to decrease overweight and obesity prevalence among adolescents by promoting healthy food choices. However, no significant differences between the intervention and control groups were detected. The *HEROS* intervention sought to decrease overweight and obesity prevalence by increasing fruit, vegetable, and dairy product intake, which were hypothesized to improve the nutrient density of the diets of participants. It is likely that no significant improvements in overweight and obesity prevalence were observed for several reasons. First, dietary intake in the intervention group was not improved for fruit or dairy products as hypothesized. Thus, it is not surprising that no significance was found. Secondly, the intervention did not address physical activity, an equally important component of the energy balance equation. Planet Health[37] included intervention components to address physical activity in addition to dietary intake and was successful in decreasing obesity prevalence among females. However, New Moves[54] failed to improve body weight among its participants. Thirdly, the *HEROS* intervention lasted only 23 weeks. In contrast, Planet Health was a two-year intervention. Thus, interventions that address physical activity as well and are of longer duration have a greater likelihood of positively impacting body composition.

There are limitations that must be considered when applying the results of this study. The population studied included only seventh grade students. Thus, the results are applicable to seventh graders that both speak and read English and do not have other special education needs. Dietary intake at school was estimated using a food diary tool (the OSFD) that needs additional validation to indicate its ability to accurately and reliably report student food intake at school. Incremental exposure was not tested, thus it is not known which components of the program where most effective. This study lasted only one school year. Therefore, the ability of the program to sustain or continue to impact dietary choices of students is not known.

CONCLUSIONS/APPLICATIONS

- The *HEROS* intervention significantly increased vegetable consumption at school among seventh graders and the overall daily intake of vegetables among African American seventh graders.
- School-based environmental and educational interventions have the potential to positively impact the dietary habits of school youth.
- Research efforts are needed to provide cost and benefit analyses of intervention components that impact healthy eating behaviors, especially among groups at risk for diet-related health disparities.
- Initiatives are needed to set environmental and curricular school policies that support research-based interventions to influence healthy eating behaviors of students.

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Table 7.1. Characteristics of participants at baseline[‡§]

	Intervention Participants (N=220)	Control Participants (N=269)
Age, y[£]	12.7 (0.46)	12.7 (0.46)
Female, %	55.2	54.6
Ethnicity, % White	54.7	62.3
African American	33.8	28.1
Other	11.4	9.6
Low SES, %	27.2	26.4
Obese[¶], %	19.2	19.4
Overweight[€], %	29.0	29.4
Fruit, servings/d[£@]	2.03 (2.01)	1.99 (1.86)
Vegetables, servings/d[£@]	1.69 (1.53)	1.71 (1.61)
Dairy, servings/d[£@]	3.22 (3.01)	3.38 (3.13)
Fruits, servings at school lunch/d[£+]	0.38 (0.46)	0.41 (0.46)
Vegetables, servings at school lunch/d[£+]	0.21 (0.20)	0.20 (0.21)
Dairy, servings at school lunch/d[£+]	0.77 (0.74)	0.73 (0.61)
Activity Level, %[Δ]		
Met recommendation	57.1	61.9
Did not meet recommendation	42.9	38.1

‡ Sample sizes vary slightly due to missing data.
§ Abbreviations used: YAQ, Youth and Adolescent Food Frequency Questionnaire; SES, socioeconomic status; OSFD, O'Connell School Food Diary; TSF, triceps skinfold thickness; BMI, body mass index.
£ Values are expressed as mean (standard deviation).
¶ BMI-for-Age $\geq$ 85th percentile
€ BMI-for-Age $\geq$ 85th percentile and TSF-for-Age $\geq$ 85th percentile
@ Measured using the YAQ, expressed as servings per day.
+ Measured using the OSFD, expressed as servings eaten at school lunch
Δ Recommendation of 20 minutes of vigorous exercise $\geq$ 6 d/14 d, North American Society of Pediatric Exercise Medicine

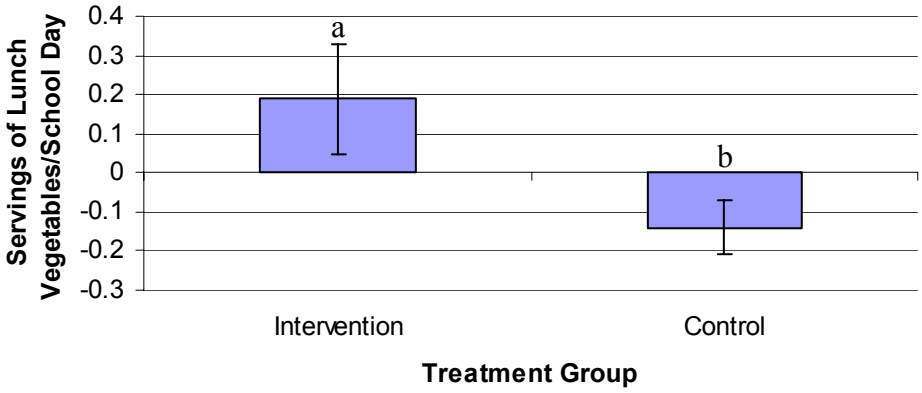

Figure 7.1. Changes in average estimated servings of vegetables consumed at school lunch in intervention and control groups. Change scores represent follow-up minus baseline values for estimated mean intakes of vegetables consumed at lunch on school days as estimated using the O'Connell School Food Diary. Bars are means ± standard error derived from least squares analysis adjusted for gender, ethnicity, and socioeconomic status. Bars not sharing a superscript are significantly different ($P < 0.05$).

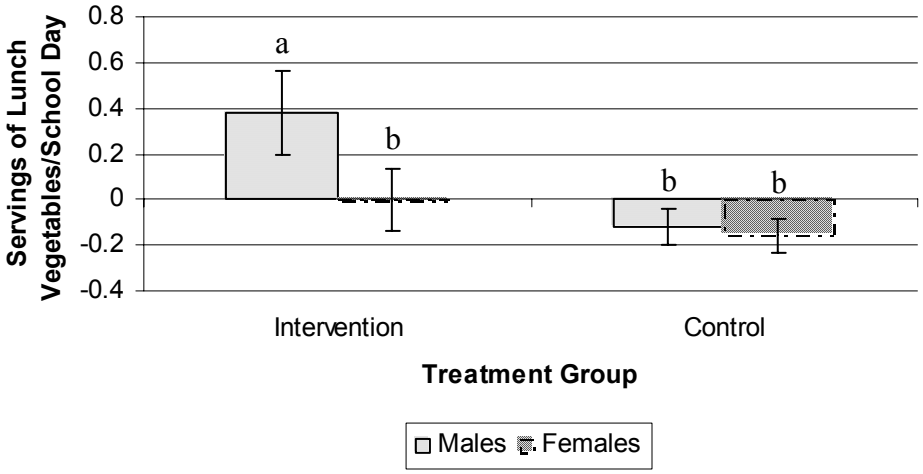

Figure 7.2. Changes in average estimated servings of vegetables consumed at school lunch in intervention and control groups stratified by gender. Change scores represent follow-up minus baseline values for estimated mean intakes of vegetables consumed at lunch on school days as estimated using the O'Connell School Food Diary. Bars are means ± standard error derived from least squares analysis adjusted for ethnicity and socioeconomic status. Bars not sharing a superscript are significantly different ($P < 0.05$).

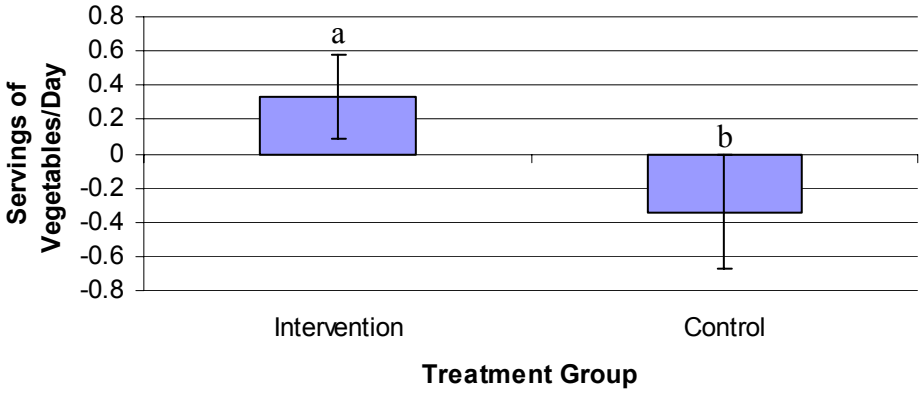

Figure 7.3. Changes in average estimated servings of vegetables consumed per day in intervention and control groups stratified by African American ethnicity. Change scores represent follow-up minus baseline values for estimated mean intakes of vegetables consumed per days as estimated using the Youth and Adolescent Food Frequency Questionnaire. Bars are means ± standard error derived from least squares analysis adjusted for gender and socioeconomic status. Bars not sharing a superscript are significantly different ($P < 0.05$).

CHAPTER VIII

EPILOGUE

Based on what I have learned through the process of conducting the *HEROS Study*, I have several ideas that would form the "next step" in my research process. If I had the opportunity to improve on my study by completing this "next step," I would redesign the program and then implement the new design in a larger sample of schools, possibly a sample of twenty schools. I would first begin with focus groups with parents, student, and school staff from a sub-sample of schools. The goal of my focus groups would be to evaluate the needs and wants of individuals concerning the tools and skills needed to feel able to prevent or manage obesity.

After conducting focus groups, I would be more capable of understanding the educational resources that parents, students, and school staff need to assist them in adopting healthy habits (i.e., healthy food choices and increased physical activity). For example, parents may need resources to help them understand if they should worry about their child's eating patterns. Parents may prefer a telephone hotline or e-mail query option on a website rather than a pamphlet that is less personal and interactive. Students may feel that they need guidance and reassurance that they are making healthy choices. A program such as Winner's Circle may be useful for middle school students. Winner's Circle is a program that uses a set of guidelines to label healthy food choices and

combination meals. It has been used in work sites, restaurants, and schools, particularly elementary schools. School staff may prefer workshops or class lesson plans. I would use the ideas from focus groups to then redesign the *HEROS* interventions program.

First, the program would involve training the school staff (i.e., principals, teachers, and cafeteria staff) so that they can implement the intervention components instead of the researchers implementing the intervention components. When researchers implement the intervention they know the intervention components were done right, but it leaves less opportunity for the changes to become permanent. By teaching the school staff how to implement the intervention, the schools themselves will become accountable for continuing with the intervention and sharing their experiences with other schools.

As a component of staff training, I would develop a more in depth education program for cafeteria staff. Cafeteria workers are at risk for poor nutrition. I feel that by educating them about the obesity epidemic among children and empowering them by teaching them how they can positively impact the health of the children they serve, cafeteria staff will not only develop better eating habits, but they will be accountable for what students eat. I would like to show cafeteria staff that they can positively change students food choices by merely asking students, “What vegetable would you like today?” instead of only “Do you want a hamburger or chicken fillet?” It is simple ideas like this one that will change school food service. However, these small ideas must become regular practices and school policies for them to become stable, positive influences on student food choices.

Second, I would keep all of the current intervention components and add a physical activity component to the intervention. I would collaborate with an exercise science research group to complete the physical activity aspects of the study design and intervention and implementation. Nutrition intervention is essential, but physical activity is just as important. Through the *HEROS Study*, I worked with Physical Education teachers to coordinate the anthropometric measures from participants. At the conclusion of the program, the teachers completed an exit package where they provided feedback. Physical Education teachers said that they know that nutrition is important, but physical activity is too. I was glad to see that they were opinionated about this topic and I feel that a nutrition/physical activity intervention would be more successful.

Research has shown that nutrition interventions that use peer leaders for delivering nutrition education are the most successful.[12] After spending a great amount of time with the students at the six schools in the *HEROS Study*, watching them eat and interact, I know they have opinions regarding how they want to eat healthy. School Nutrition Services makes decisions for students regarding what they like. Although we were all once children, as adults, we no longer think, see, smell, or taste like children. Students should be actively involved in the process of making school foods healthy and appealing. Adolescence is a time of developing autonomy. Students want to be treated with respect. By feeding them foods that are not healthy and acceptable, students are not fed with respect. If I had the opportunity, I would develop intervention strategies that utilize the students as active contributors to the design and implementation of the intervention. I would also ask for feedback on the resources and environments they need

to make successful changes. I would create student action groups to create new healthy menu items and advocate for good nutrition. Students relate to students and students can make healthy eating the norm if given the right support.

To support student action committees, I would also extend nutrition education to school athletic teams. When students are young, they can perform well physically, even with poor nutrition. As we grow into our teens and become young adults, we realize more and more that we need proper nutrition to continue to perform well. Teaching young athletes how to eat a balanced diet and avoid high sugar, high fat foods will utilize their motivation to do well in sports to establish or maintain healthy eating habits. This tactic will help healthy eating return to the norm, because students who look up to "popular" school athletes may aspire to follow in their foot steps in attempt to attain the same social success. Attainment of social success drives many behaviors of adolescents and young adults, often in a negative way. However, targeting adolescent eating and physical activity behaviors from a social perspective will create new social norms. Other peer role model groups, such as student council and junior civitans, should be identified and interventions should utilize these social networks in designing and implementing interventions.

In regards to the nutrition intervention components of the *HEROS Study*, I still feel that the interventions should target the students and the adults who influence students. I also feel that the intervention components should be multi-level and integrated into the curriculum and school environment. It would be additionally helpful if a health component were integrated into the school's statement of purpose. If a school can say

"Our middle school strives for academic achievement through educational instruction and supporting the health of our students and staff" then schools can take small steps to reach this vision.

My vision of how school cafeteria environments should be has not changed. Although the *HEROS Study* was successful in making changes, the changes made only cracked the surface of impact. There are still many other environmental intervention components that I would like to investigate. For example, vending machines must change. Vending machines are not the problem; what they offer is the problem. Soft drinks need to be better defined. I define soft drinks as any sugar-sweetened beverage, carbonated or non-carbonated. However, schools still don't see Fruitopia and Chiller beverages as soft drinks, because they are not carbonated. They are in violation of the Competitive Foods Act that states that soft drinks cannot be served during school hours. Better defining a soft drink can utilize the Competitive Foods Act to ensure that these beverages are not available for students.

Finally, I would develop a process evaluation plan for school staff to complete to document the progress and evaluate the degree of implementation of the program. In the *HEROS Study*, I monitored the degree to which interventions were implemented. However, it is not practical or valid to have an individual evaluate the degree of implementation in lager studies. A series of surveys can be developed that record the frequency of intervention implementation. This is especially important in larger studies, because schools will not complete the activities to the same extent. However, if you know

the degree to which the interventions were completed, you can adjust your analyses and still have valid outcome measures.

Except for the addition of a formal process evaluation, I would keep the remaining outcome measures the same. I was very pleased with the success of acquiring data through the *HEROS Study* and recommend future studies to use the same tools and techniques that I used. I would, however, create an alternate version of the "Effective School Intervention Survey" (ESIS) to be administered to control participants to evaluate if extraneous nutrition interventions reached them. This is especially important for future studies, because as new public health campaigns are developed students will be positively impacted to a greater degree by the media.

In addition to extending my research by improving on the *HEROS Study*, I want to help schools establish monitoring programs for childhood obesity. Schools are an excellent place for this type of public health screening. However, screening means that once we know that a child has health risks, ethically, we must provide help. Establishing a program to measure obesity among youth would be the first component of the program. The most difficult component would be answering the question, "What do we do now that we know?" Thus, the second component would be designing guidelines and resources for students and parents. Guidelines must not harm and they must help. Otherwise, knowing that a child is at risk may do more harm than good. We do not know how parents will react to knowing their child has been identified as obese. Many will take it personally and they may even blame their children. They may resort to enforcing behavior changes for their children that can be detrimental to their mental and physical

growth. This area of research is very important for initiatives to address childhood obesity from a public health perspective. This approach is inevitable and the sooner good research begins the sooner resources can become available for the frustrated parents, teachers, and students that are dealing with childhood obesity every day.

With that said, my last activity of the *HEROS Study* will be to present the results of the study to the Guilford County School System. I hope that the efforts that went into this program and the outcomes that resulted will inspire others to move forward with future opportunities to provide programs that resolve the growing needs of our community.

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Appendix A

A glossary of terms for describing the school environment.

National School Lunch Program (NSLP)

Established under the NSL Act in 1946 with the objectives "to assist States, through cash grants and food donations, in making the school lunch program available to school children and to encourage the domestic consumption of nutritious agricultural commodities" (DHHS, 2003).

School lunch

Meals provided through the NSLP. School lunches must meet the Dietary Guidelines for Americans for percent calories from fat and saturated fat and must provide one-third of the Recommended Dietary Allowances (RDA) for protein, vitamin A, vitamin C, iron, calcium, and calories (United States Department of Agriculture [USDA] 2003). School lunches are made up of a combination of three to five *components*.

School lunch components

There are five components of a NSLP school lunch: milk, meat/meat alternative, bread/grain product, fruit/fruit juice, and vegetables. Components can be combined (e.g., cheese pizza includes a bread and a meat alternative component). When three to five components are purchased together the student pays the NSLP price (e.g., regular $1.80, reduced $0.40, or free). Components can also be purchased individually.

Milk

Eight ounces (one cup) of only 100% milk of any percent fat or flavor.

Meat/meat alternative

Two ounces of meat or cheese.

Bread/grain product

Two ounces of bread or any other grain product (e.g., pizza crust, pita bread, saltine crackers).

Fruit/fruit juice

Four ounces (1/2 cup) of 100% fruit juice of any flavor or canned or chopped fruit/fruit salad or one whole medium fruit.

Vegetables

Four ounces (1/2 cup) of 100% vegetable juice of any flavor or canned or chopped vegetable/vegetable salad.

Entrée

Combined components served as a unit in a meal (e.g., pizza, hamburger, cheese burger, nachos with meat and cheese). May also be purchased separately as an a la carte item.

Free lunch

Students can qualify to receive a NSLP school lunch for free (regular price $1.80) if their family income is less than 130% of the poverty line.

Reduced price lunch

Students can qualify to receive a NSLP school lunch for a reduced price of $0.40 (regular price $1.80) if their family income is between 130% and 185% of the poverty line.

Snack bars/a la carte lines

Locations in school cafeterias where foods are sold that do not qualify as components of a NSLP school meal and are considered in competition with NSLP components. Snack bars/a la carte lines are usually manned by school staff.

Vending machines

Machines in the cafeteria or in any other location throughout the school environment that sells foods that do not qualify as components of a NSLP school meal and are considered in competition with NSLP components.

School stores

Locations in schools that are not in the school cafeteria where foods are sold that do not qualify as components of a NSLP school meal. These foods may be considered in competition with NSLP components if they are sold during or around meal times. School staff or students may man school stores.

Food line

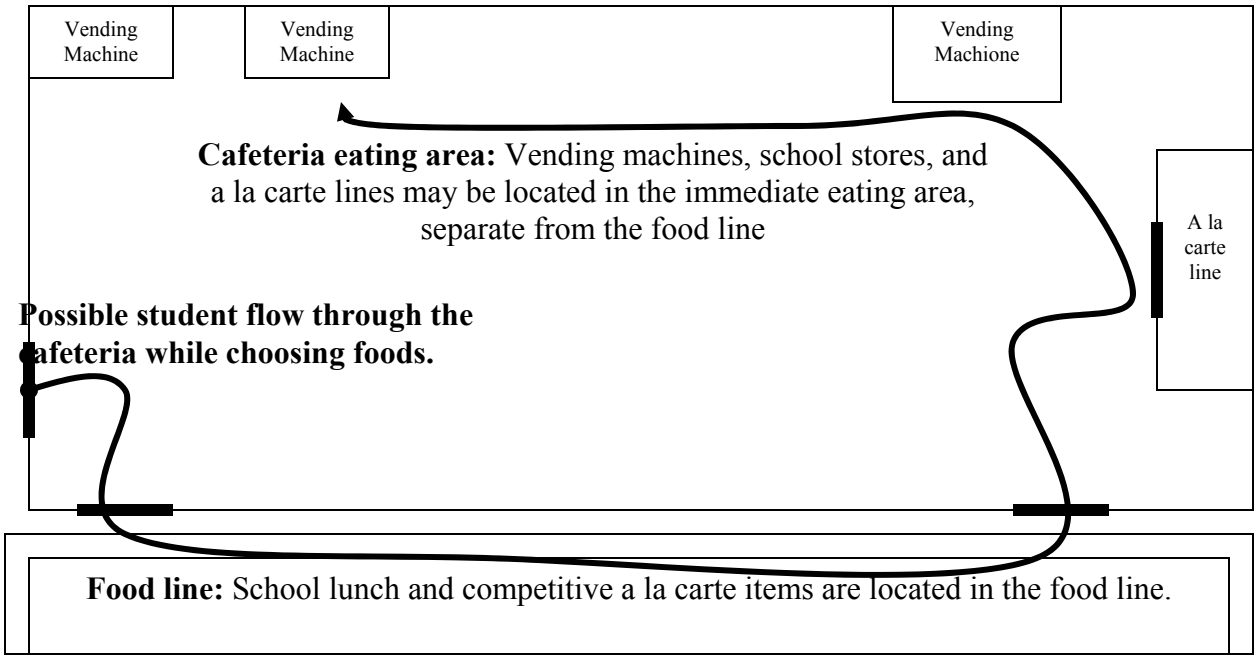
The food line is where hot and cold foods are served to students through the NSLP and is the primary intended locations for foods for students. *Competitive foods* are usually also served on the food line.

Competitive foods

Competitive foods can be sold anywhere in the school environment. Those sold on the food line, on snack bars, and in school stores are often referred to as "a la carte" items. Other competitive foods are those in vending machines. Competitive foods are those considered to be in competition with the NSLP foods. Competitive foods are generally higher in sugar, fat, and/or calories compared the NSLP items and appeal to students. Companies that supply competitive foods to school often market their products to students (e.g., soft drink vendors using advertisements in schools).

Diagram of cafeteria

Location of food venues are indicated below:



Appendix B

Consent Forms

GUILFORD COUNTY SCHOOLS **Please return to teacher.**

Guardian/Parent Research Consent Form
To be completed by the parent/legal guardian **and** school aged participant under 18 years.

Project Name Food choices and weight status of seventh graders in GCS middle schools

Sponsoring Organization UNC Greensboro

Principal Researcher(s) Dr. Michael McIntosh Telephone 256-0325

Project Location(s) TBA

Student's Name _____

Home Address _____ Telephone _____

Student's School _____ Grade 7th Age _____

Participants/Parental rights and Assurances
I have received a copy of the approved Guilford County Schools Research Application Form for the aforementioned research project. Having read the application I am familiar with the purpose, methods, scope, and intent of the research project.

I am **willing** for my child to participate in the research project.

I understand that during the course of this project my child's responses will be kept strictly confidential and that none of the data released in this study will identify my child by name or any other identifiable data, descriptions or characterizations. Furthermore I understand that my child may discontinue his/her participation in this project at any time or refuse to respond to any questions to which he/she chooses not to answer. My child is a voluntary participant and has no liability or responsibility for the implementation, methodology, claims, substance or outcomes resulting from this research project. I am also aware that my child's decision not to participate will not result in any adverse consequences or disparate treatment due to that decision.

I fully understand that this research is being conducted for constructive educational purposes and that my (parent) signature gives consent for my child to voluntarily participate in this project.

Parent's Signature _____ Date _____

My (student) signature below indicates that I am willing to participate in this project.

Student's Signature _____ Date _____

Appendix C

Educational Pamphlets

Soft Drinks and School-Age Children:

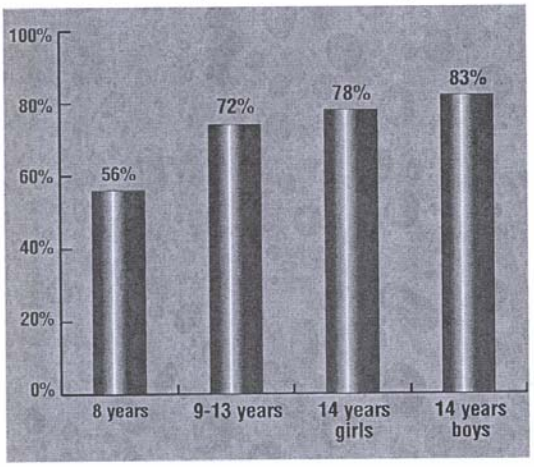
Trends
Effects
Solutions

Trends in Soft Drink Consumption

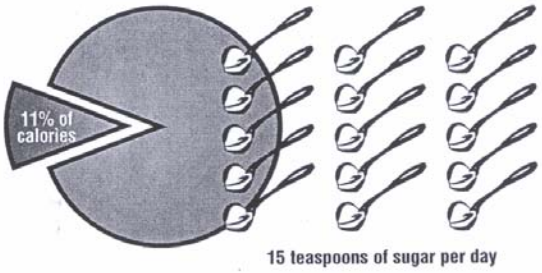
According to the USDA, the per capita soft-drink consumption has increased almost 500% over the past 50 years. Soft drinks include soda, fruit-flavored and part-juice drinks and sports drinks. Half of all Americans consume soft drinks daily—most of which are sugar-sweetened.[1] Soda is the soft drink most frequently consumed. Enough regular soda is produced to supply EVERY American with over 14 ounces of soda every day.[2] The availability of soda in the U.S. now exceeds that of milk.[3] This is a growing concern for children and adolescents.

Children start drinking soda at a remarkably young age and consumption increases through young adulthood.[4] Fifty-six percent of 8-year-olds consume soft drinks daily and a third of teenage boys drink at least three cans of soda a day.[5] On average, adolescents get 11% of their calories or 15 teaspoons of sugar from soft drinks.[4] This high consumption of sugar is contrary to the Dietary Guidelines for Americans 2000 which recommend choosing sensibly to limit intake of beverages and foods that are high in added sugar.

Percent of Children Drinking Soft Drinks Daily[5]



Soft Drink Contribution to Diets of Adolescents[6]

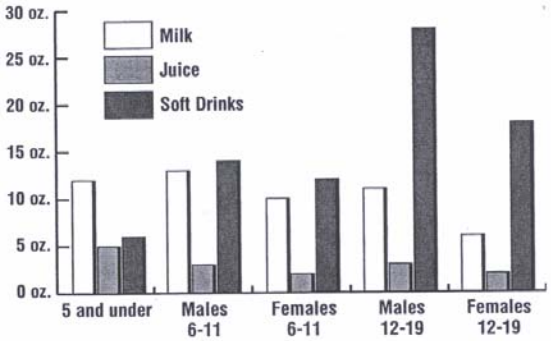


One reason for the increasing consumption of soft drinks is that the industry has steadily increased container sizes. In the 1950s, a 6 1/2-ounce bottle was the standard serving. That grew into the 12-ounce can. Those are now being replaced by 20-ounce bottles.[4]

Not only are soft drinks contributing significant amounts of calories and sugar to the diets of children and adolescents, they are also replacing milk as the beverage of choice. In fact, teenage boys and girls are drinking twice as much soda as milk.[4]

Beverage Consumption of Children and Adolescents in the U.S.

(Average quantities [in ounces] per day)[6]



The Health Effects of Soft Drink Consumption

When children and adolescents replace milk with soft drinks, they lose out on valuable nutrients needed for normal growth and development. Only 36% of boys and 14% of girls are getting enough calcium. High soft-drink consumption is also correlated with low intakes of magnesium, vitamin A, vitamin C and riboflavin, as well as high intakes of calories, fat and carbohydrates.[4]

Nutrient Composition of Non-diet Soda, Orange Juice and Low-fat Milk[2]

	Non-diet Soda	Orange Juice	1% Milk
	Per 12-ounce serving		
Calories, kcal	160	168	153
Vitamin A, IU	0	291	750
Vitamin C, mg	0	146	3
Calcium, mg	0	33	450
Magnesium, mg	0	36	51
Potassium, mg	0	711	352

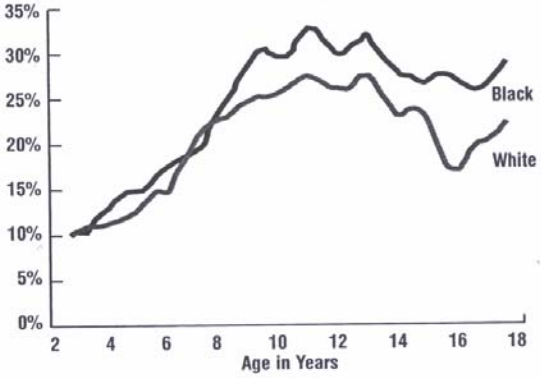
According to the 2001 Surgeon General's *Call to Action to Prevent and Decrease Obesity*, today there are nearly twice as many overweight children and almost three times as many overweight adolescents as there were in 1980.[7] Initial results from the 1999 National Health and Nutrition Examination Survey (NHANES), using Body Mass Index (BMI), indicate that an estimated 13 percent of children ages 6-11 years and 14 percent of adolescents ages 12-19 years are overweight.[8] BMI, an index of a person's weight in relation to height, is commonly used to classify overweight and obesity among adults, and is also recommended to identify children who are overweight or at risk of becoming overweight. Children with a BMI ≥ 85th percentile but < 95th percentile are at risk for overweight and children with a BMI ≥ 95th percentile are overweight.[8] North Carolina 2000 data from children seen in public health settings show an even greater increase in the number of overweight children.[9]

Percent of North Carolina Children Who Are Overweight[9]

	1995	2000	Increase
Ages 2-4	9.0%	12.2%	36.6%
Ages 5-11	14.7%	20.6%	40.1%
Ages 12-18	22.7%	26.0%	14.5%

Various environmental and social factors are contributing to this trend. The increasing consumption of sugar-sweetened soft drinks has been identified as one factor. A recent study of 12-year-olds found that for each additional serving of sugar-sweetened drink consumed daily, both BMI and frequency of overweight increased by 60% after adjustment for anthropometric, demographic, dietary and lifestyle variables.[1]

Prevalence of Overweight (BMI>=95th Percentile) White and Black Children by Age North Carolina, 2000[9]



There are other health risks associated with excessive soft drink consumption. Low calcium intake contributes to osteoporosis, a disease leading to fragile and broken bones. The risk of osteoporosis depends in part on how much bone mass is built in early life. For girls, 92% of their bone mass is built by age 18 and if they are not consuming enough calcium during their teenage years, they cannot catch up later.[4]

Solutions to Reverse the Trends in Soft Drink Consumption

The Regulations

Research shows that there is a direct link between good nutrition and the ability to learn, play, grow and develop. Well-nourished children have higher test scores, better school attendance and fewer behavioral problems.[10] Schools are important environments that impact children's nutrient intake. There are minimal regulations in place that foster the development of healthful eating habits.

The United States Department of Agriculture (USDA) has established regulations to control the sale of foods of minimal nutritional value in the food service area during school meal periods. The only foods included in this definition are carbonated beverages, hard candies, water ices (flavored ices) and chewing gum. USDA also allows states to establish such rules as necessary to control the sale of other competitive foods. Competitive foods are defined as any foods sold in competition with reimbursable school meals.

In 1976, the North Carolina State Board of Education adopted a policy stating that all food and beverages sold in the school must contribute to the nutritional well being of the child and aid in establishing good food habits.[11] This standard was changed by North Carolina Statute 115C-264 (1991) and states that each school may, with the approval of the local board of education, sell soft drinks to students so long as soft drinks are not sold (i) during the lunch period, (ii) at elementary schools, or (iii) contrary to the requirements of the National School Lunch Program.

The National Association of State Boards of Education (NASBE) recommends that elementary school students not have access to food or beverages in vending machines. The recommendation for middle and high schools provides two options: 1) no access during school hours or 2) no access until 30 minutes after the end of the last lunch period.[12] Despite the recommendations of NASBE and other health and education organizations, many school policy officials are making different decisions, as they face mounting pressure to do more with less. The public is demanding qualified teachers, smaller classes and better-equipped facilities. However, schools may not be receiving adequate funds to fully address all these concerns. Many educators are responding to these pressures by considering nontraditional funding sources, including a proliferation of vending options.

Some school systems have chosen to contract with a soft drink company for the sole sale of one brand, which is referred to as a "exclusive beverage" or "pouring rights" contract. A significant part of the funding comes in an immediate lump sum with subsequent revenues tied to sales. It is important that contract terms be reviewed for language to avoid incentives that encourage students to increase their consumption of soft drinks.

Vending Machine Placement and Operation

Many middle/junior and high schools have employed strategies for limiting the sale of foods and beverages from vending machines.

- **Keep all vending machines turned off during regular school hours.**
- **Keep the machines off until the end of the last lunch period.**
- **Prohibit the sale of "foods of minimal nutritional value" until 30 minutes after the last lunch period.**
- **Prohibit the sale of soft drinks until the end of the school day.**
- **Place vending machines in out-of-the-way places to discourage their frequent use.**
- **Place vending machines far from the dining areas to optimize students' participation in the school food service program.**

Influencing Access to Soft Drinks in Schools

School districts that choose to rely on revenue generated from vending machines to pay for school site needs should make every effort to work towards the Healthy People 2010 objective of ensuring that all foods available at school contribute to good dietary quality. The Healthy Carolinians 2010 objectives that call for reducing the percent of children and adolescents who are overweight and obese; and reducing the percent of students who eat high-sugar snack foods on a given day[13] support this national objective. The following recommendations will aid schools in striving for these objectives.

- **Adhere to federal regulations and state and local policies regarding competitive foods, including soft drinks, sold in vending machines.**
- **Work with community partners to develop a comprehensive school nutrition policy that addresses appropriate beverage choices.**
- **Create demand for nutritious beverages by working with nutrition educators to design and implement educational and marketing activities.**
- **Never include incentives for increasing students' consumption of soft drinks in vending agreements. Ensure that signage, banners and advertising are prudent and that instructional areas are free of commercial advertising.[12]**
- **Guide sales in a more positive direction by including the following guidelines in vending agreements:**
  - 100% fruit or vegetable juice, milk and bottled water are readily available throughout the day.
  - 100% fruit or vegetable juice, milk and bottled water are sold at attractive prices.[12]
  - Soft drink container sizes are moderate[12] (12 ounces rather than 20 ounces).
- **Provide vending machines with low-fat and skim milk, including chocolate, strawberry and other popular flavors.**
- **Provide bottled water in vending machines and ensure access to water at no cost by having an adequate number of strategically placed water coolers.**

Students Make Healthier Choices

Two school systems have demonstrated that when given a choice and with the right packaging and marketing mix, students will make healthful choices.

A School Board in **Madison, Wisconsin** decided not to renew an exclusive vending contract with a soft drink company. The board voted to continue selling soda in schools but with multiple vendors. It also pledged to add healthier beverages. A milk vending machine was installed at each of the four main high schools. Four flavors of milk are available: chocolate, chocolate malt, reduced-fat white and reduced-fat strawberry. The milk and juice machines stay on all day, while most of the soda machines are disabled during school hours. Students can buy milk and orange juice between classes and during some study halls, not just before and after school. While there were many skeptics, the schools now struggle to keep the milk vending machines stocked. The machines hold 16-ounce bottles of milk that sell for $1.00.

In an attempt to increase the milk intake by teenagers, milk vending machines were installed in eleven high schools in **Miami-Dade County in Florida** as a pilot program of the dairy industry. The machines dispense colorful and resealable bottles of chocolate, strawberry and unflavored regular and low-fat milk for $1.00. The initial response exceeded expectations. Machines run out of milk almost daily. The machines are placed next to or near soda and snack vending machines.

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Dear Advocate for Healthy Children:

The increasing level of soft drink consumption by North Carolina's children and teens is one of many barriers to their achieving an adequate diet and a healthy lifestyle. It is a trend that parents, schools and communities have the capacity to reverse. This publication focuses primarily on schools; however, schools cannot solve the problem alone.

Parents can:

- Help children learn to enjoy water as the thirst quencher of choice.
- Provide a variety of low-fat milks and 100% fruit and vegetable juices that are high in nutrients.
- Provide access to soft drinks as a "sometimes" beverage to be enjoyed in moderate amounts.
- Be a role model by making healthy beverage choices.

Communities can:

- Advocate for healthful environments that are consistent with classroom nutrition education.
- Secure funding for marketing campaigns focused on healthful eating.
- Work through community partnerships to ensure that milk, water and other nutritious beverages are offered wherever less nutritious beverages are available.
- Fund education so that schools do not compromise the health of children and youth by raising funds through the sale of foods and beverages low in nutrients and high in calories.

Increased consumption of soft drinks is a high profile issue that provides an extraordinary opportunity to raise awareness of the unintended health consequences of personal and group decisions. Successful change in this area can lead to improved policy in other areas that will help ensure a healthy future for North Carolinians.

Yours for a Healthy North Carolina,
The School Nutrition Action Committee

For questions or comments, please contact: SNAC@ncmail.net

Developed by the North Carolina School Nutrition Action Committee (SNAC)
SNAC consists of representatives from three state governmental agencies that participate in school nutrition services including the Department of Public Instruction, the Department of Health and Human Services and the NC Cooperative Extension Service. The goal of this committee is to coordinate school nutrition activities that link the cafeteria, classroom and community to school health.

These institutions are equal opportunity providers.
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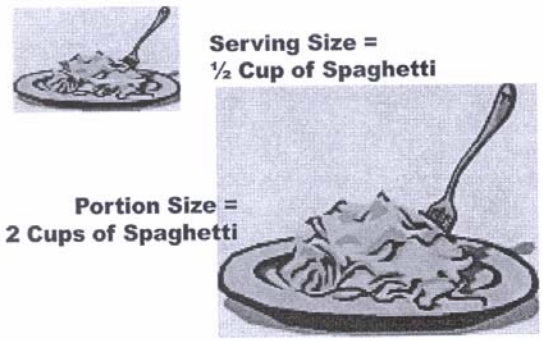
Portion Sizes and School-Age Children:

Trends
Effects
Solutions

Trends in Portion Sizes

More than 60 percent of adults in the U.S. are overweight or obese, and there are twice as many overweight children and three times as many overweight teens as there were two decades ago.[1,2] Part of the problem is that Americans are eating more and physical activity has not increased to maintain energy balance. Between 1970 and the late 1990s, the daily food supply in America increased by 500 calories.[3] Although food supply is an overestimation of what people eat, dietary intake surveys show an average increase of more than 200 calories per day.[3] Even small increases in calories can translate into significant weight gain. One contributing factor is an increase in portion sizes.

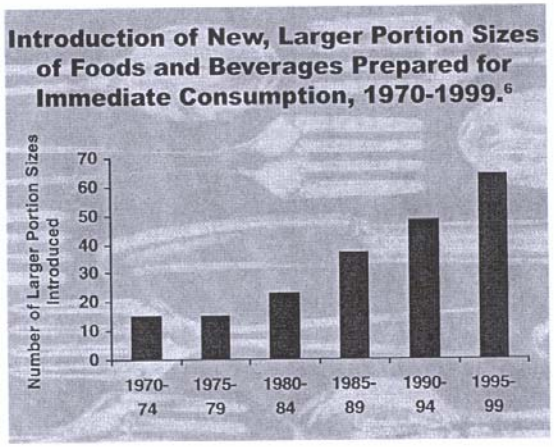
"Portion size" is defined as the amount of food one chooses to eat.[4] There are no standards for portion sizes. On the other hand, a "serving size" is a standard amount that gives guidance as to how much to eat or identifies how many calories and nutrients are in a food.[4] The USDA Food Guide Pyramid provides serving size recommendations to guide people in selecting their daily food intake. For example, one half cup of spaghetti (just the pasta) is one serving from the Grain Group. If you eat two cups of spaghetti for dinner, you are actually eating four servings.



Depending on age, gender and activity level, this could amount to one-third to two-thirds of the daily recommendation for the Grain Group. While there is nothing wrong with eating a "portion size" that is more than one serving, it is important to know the difference between a portion and a serving. If you eat a portion that is actually several servings, you need to balance that with the other foods eaten in the day. The portion sizes of a majority of foods sold for immediate consumption far exceed the Food Guide Pyramid serving sizes.[5] Indeed, our perception of what a serving size is has been altered by the increasing availability and marketing of larger food portions.

The introduction of larger-size portions in away-from-home and marketplace foods has increased significantly.[6] Bagels used to weigh between 2-3 ounces. Today, the average bagel weighs 4-7 ounces.[7] The eight-ounce soft drink has become 20 ounces and the average theater serving of popcorn has gone from three cups to 16 cups.[8] A typical hamburger in 1957 contained a little more than one ounce of cooked meat, compared to as much as six ounces in 1997.[8] The trend toward larger portion sizes is most evident in restaurants and fast food outlets but is also significant in homes.[5] One example is observed in recipes used at home. Newer editions of classic cookbooks such as *The Joy of Cooking* contain recipes identical to earlier versions, but yield fewer and therefore, larger portions than before.[6]

Meal combos or value meals have become increasingly popular. Fast food chains offer more food for only a slight increase in cost. This supersizing of meals



encourages Americans to buy and eat more food under the premise that it is a good value. For only 29¢ - 49¢, a fast food meal is supersized by as much as 400 calories. Super-combo meals, which include a large drink and fries, are often less expensive than the same sandwich with a small drink and fries.[7] Fast food chains are not the only eating establishments increasing portion sizes. Many restaurant orders are so large that the Food Guide Pyramid daily recommendations for some food groups can be met in a single meal.[4] Larger portion sizes can easily shift a healthful meal to one of excessive calories, fat, sugar and sodium.

1957
1-ounce hamburger

1997
6-ounce hamburger

Children are not immune to the increase in portion sizes. Fast food chains are now targeting children ages 7 to 12 with supersized versions of their popular kids meals.[9, 10] By increasing the regular hamburger to a double hamburger or double cheeseburger, the calorie content of the meal increases by 100-180 calories.[11, 12]

In the past, many people considered eating out to be a special treat. Indulging in a large meal at a restaurant or fast food outlet was easily balanced with more moderate meals eaten throughout the week. However, several societal shifts – such as an increase of women in the workforce, dual-income households and smaller household sizes – have increased the demand for foods prepared away from home. In addition, away-from-home foods are now more affordable and accessible than ever before. Away-from-home food consumption has increased by two-thirds from 1977 to 1995.[13] Half of the meals eaten away from home are fast foods.[8] As children get older, the proportion of meals eaten away from home increases from 18 percent in preschoolers to 30 percent in adolescents.[13]

Health Effects of Larger Portion Sizes

Have you ever walked into a donut shop to get a half dozen donuts and discovered that you could get one whole dozen for the same price? What would you do? Many consumers would opt for the dozen.

Consumers shop for value! Surveys show that consumers will choose to dine at restaurants based on the portion sizes that are served. A recent study shows that increasing the portion size affects food intake in adults in a single meal. There was a significant relationship between the amount of food offered and the amount eaten.[14]

Larger portions of high-calorie, high-fat foods are one of several environmental and societal trends contributing to the increase in overweight adults and children. According to the 2001 Surgeon General's *Call to Action to Prevent and Decrease Overweight and Obesity*, there were nearly twice as many overweight children (13 percent) and almost three times as many overweight adolescents (14 percent) as there were in 1980.[15] A 2002 study in the Journal of the American Medical Association indicated the prevalence of overweight among children and adolescents has continued to increase. The prevalence of overweight was 15.5 percent among 12- to 19-year-olds, 15.3 percent among 6- to 11-year-olds and 10.4 percent among 2- to 5-year-olds. 2001 North Carolina data from children seen in public health settings show an even greater increase in the prevalence of overweight children.[16]

Percent of North Carolina Children Who Are Overweight.[16]

	1995	2001	Increase
Ages 2-4	9.0%	12.0%	33.3%
Ages 5-11	14.7%	20.3%	38.1%
Ages 12-18	22.7%	26.3%	15.9%

Studies have indicated that overweight children (especially adolescents) are at higher risk of becoming obese adults.[17] The likelihood that childhood overweight will persist into adulthood ranges from approximately 50 to 70 percent, increasing to 80 percent if one parent is overweight.[18,19] Obesity is no longer a concern for adults only. Signs of chronic disease associated with obesity are showing up in overweight children. These include:

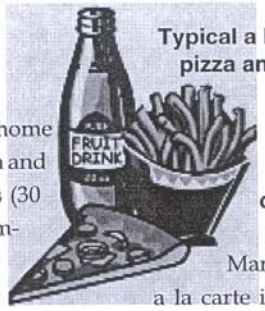
- Atherosclerotic plaques[20]
- Hypertension[21,22,23]
- Increased triglycerides[21,23]
- Increased insulin resistance and Type 2 diabetes[20,24]

Portion Sizes in Schools

Schools are the main providers of away-from-home meals (36 to 42 percent) for school-aged children and adolescents, followed by fast food restaurants (30 to 32 percent).[13] Compared with other away-from-home foods, the National School Lunch Program (NSLP) provides better-quality foods that are relatively rich in fiber, calcium and other vitamins and minerals, and lower in added sugars.[25] Furthermore, the portion sizes in NSLP meals are generally consistent with the serving sizes recommended in the USDA Food Guide Pyramid. Although there is no maximum number of calories that may be provided, studies show that NSLP meals provide approximately 1/3 of the RDA for calories and School Breakfast Program meals provide about 1/4 of the RDA for calories.[25]

In addition to the NSLP, there are increasing numbers of food and beverage options at school from which students choose their meals and snacks. A study of California schools found that in 71 percent of school districts surveyed, a la carte items accounted for up to 70 percent of all food sales at the schools.[26] Similar data are not available for North Carolina schools. However, while the participation rate for reimbursable meals in N.C. schools has declined 20 percentage points in the past two decades, the percent of students eating meals at school has remained steady due to an increase in a la carte sales. The trend was also observed in the School Nutrition Dietary Assessment Study-II which showed that as a la carte sales increase, participation in the NSLP decreases.[25]

Meals served under the NSLP have nutrition standards that must be met, but other foods available at school have no such standards. Many are high in fat, sugar and/or sodium, but provide few key nutrients. Compounding this problem is the fact that many of these foods tend to be made available in large portion sizes similar to those served in restaurants or available in the retail sector.

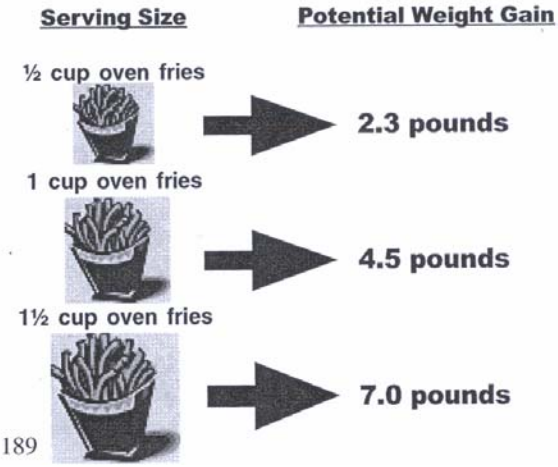


Typical a la carte lunch: fruit drink, cheese pizza and fries = 1,060 calories

One-third of the RDA for a teenage boy is 1,000 calories and for a teenage girl it is 733 calories.

Many students select their total lunch from a la carte items such as large servings of pizza, French fries, nachos and juice drinks.[24] Even students who select a NSLP lunch that meets nutrition standards often supplement it with large portions of French fries or other high-calorie foods and beverages.

An Example of the Potential Weight Gain When Eating TWO Servings of Oven Fries Per Week for 36 Weeks in Addition to the School Lunch.



Solutions for Reducing Portion Sizes

Schools have two constraints – customer demand and financial goals – that make it difficult for them to serve only foods that provide optimal nutrition and contribute to healthy weight in their students. Students who are accustomed to large portion sizes at home and in fast food restaurants also want them at school. Increasing numbers of school districts provide no local operating funds for food service programs and many operate vending machines that compete with cafeterias for students' appetites and dollars to fund extra curricular activities.

In order to reverse the supersize trend, parents, students, school officials and industry must recognize the value this will have for students' health and for future healthcare costs. They must work together toward this end. A Healthy People 2010 objective calls for ensuring that all foods available at school contribute to good dietary quality. A Healthy Carolinian objective calls for reducing the percent of children and adolescents who are overweight and obese. These objectives, along with the N.C. Healthy Weight Initiative[28] recommendation of establishing standards for all foods in schools, support action in this area. Until this occurs, communities need to engage students, parents, school officials and civic leaders to address portion sizes for all foods on school campuses. This will send a clear message to students that healthy eating is a priority for the school and community. It will also provide an environment that supports healthy choices by students.

Influencing Portion Sizes in Schools

The following recommendations will aid schools in striving to create environments that support healthy food and beverage choices by students. Following all recommendations is desirable, but phased-in implementation may be necessary in some schools.

- Ensure that School Breakfast Program (SBP) and National School Lunch Program (NSLP) meals meet all nutrition standards and provide sufficient choices of nutritious, appealing foods in portion sizes appropriate for different age groups. In middle and high schools, increase the number of NSLP meal options available for students, including such choices as Grab 'n Go Bags, pre-plated salads, salad bars and choices for hot meals – all planned to meet nutrition standards.
  - To the extent that is financially feasible, offer larger-than-required portions of fruits and vegetables without added sauces and seasonings that add calories.
  - Offer entrees that are no larger than the minimum required by USDA.
  - Offer occasional desserts in small portion sizes to help students learn to enjoy the quality, not quantity, of food.
- Limit beverage sales to water (any size), low-fat or nonfat (1% or less fat) flavored and unflavored milk, and 100% fruit or vegetable juices (no larger than 8 ounces for elementary and 12 ounces for middle and high schools).
- Permit no a la carte, snack bar and vending machine sales of individual foods in elementary schools, in order to help students learn to eat well-balanced meals that have been planned to meet nutrition standards.
- In middle and high schools, limit portions to specific sizes (examples for local consideration):
  - Snacks: 1.25 oz.
  - Cookies and cereal bars: 2 oz.
  - Bakery items: 3 oz.
  - Frozen desserts: 3 oz.
  - Yogurt: 8 oz.
  - Fries: 1 cup
  - Pizza: no more than 5 oz.
  - Entrees and side dishes: portion sizes equal to those of similar items served as part of NSLP or SBP
- Require the availability of fruits and vegetables at competitive prices and portion sizes in any venue where competitive foods are sold.

Influencing Portion Sizes in Families and Communities

Portion distortion is now the norm. While this publication focuses on schools, reversing this trend is also a challenge for families and communities.

Families provide children's first learning environment and have the potential to make that environment supportive of healthful eating patterns that include a wide variety of foods and normal portion size. Simple suggestions include:

- Prepare and eat more meals at home. We all tend to eat larger portions when we eat out.
- Help children learn what a serving looks like. For example, measure cereal in the child's bowl and discuss that a bowl of cereal and a serving of cereal can be different.
- Package snack items in individual servings.
- Provide healthy food in appropriate portion sizes and let children decide how much they will eat and help them learn to stop when full.
- When eating out, avoid all-you-can-eat buffets, supersized meals and other deals that promote overeating.
- Share restaurant meals or take part of the meal home.

Communities reflect the values and priorities of its residents. A few activities related to portion size that will reflect a priority for healthy weight in children and youth include:

- Advocate for appropriate portion sizes in vending machines in parks, recreation facilities and other community buildings.
- Advocate for a reduction of aggressive marketing of large portions of high calorie foods and beverages targeted to children.
- Advocate for adequate funding for education so that schools do not rely on funds through the sale of high-calorie individual food items that contribute to overeating.

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Appendix D

Effective School Intervention Survey

Effective School Interventions Survey

Name (first and last) _____ **Science teacher**_____

(This is a survey. Your answers will be kept private. There are no right or wrong answers.)

This year your school has been changing! Your cafeteria has been changing! People have been visiting your school to talk to you and your family about eating a healthy diet.

Directions: Think about the activities that have happened this year. Answer the questions below to tell us if any of these things helped you eat more fruits, vegetables or dairy foods and drinks.

1. Do you eat more FRUITS or VEGGIES now than you did at the beginning of the school year?

(Circle) YES NO

IF YES,
ANSWER THESE QUESTIONS:

2. What fruits or vegetables do you eat more of now?

3. Circle all of the activities below that helped you eat more fruits or vegetables:

1 More fruits and vegetables in the cafeteria

2 Signs in the cafeteria to tell me why fruits and veggies are good for me

3 Seeing other friends or adults eating fruits and vegetables

4 Learning about fruits and vegetables in Science class

5 The "5 A Day" Challenge we did in Science

6 Tasting free fruits and vegetables in the cafeteria

7 The school dinner where they talked about fruits and vegetables

8 The newsletter sent to my parents about eating more fruits and vegetables

4. Did anything else help you eat more fruits or vegetables?

5. Do you eat more DAIRY foods or drinks (milk, cheese, or yogurt) now than you did at the beginning of the school year?

(Circle) YES NO

IF YES,
ANSWER THESE QUESTIONS:

6. What dairy foods or drinks (milk, cheese, or yogurt) do you eat more of now?

7. Circle all of the activities below that helped you eat more dairy foods or drinks (milk, cheese, or yogurt):

1 More cold milk in the cafeteria

2 Signs in the cafeteria to tell me why dairy foods and drinks are good for me

3 Seeing other friends and adults having milk, yogurt, or cheese

4 Learning about milk, yogurt, and cheese in Science class

5 Tasting free milk flavors in the cafeteria

6 The school dinner where they talked about milk as a healthy drink choice

7 The pamphlet sent to my parents about soft drinks

8. Did anything else help you eat more dairy foods or drinks (milk, cheese, or yogurt)?

THANKS FOR TAKING OUR SURVEY!

Created for use by the H.E.R.O. Schools Study
The University of North Carolina at Greensboro, Department of Nutrition

Appendix E

O'Connell School Food Diary

Your Food Diary is for the UNCG study.
Turning in your Food Diary to your PE teacher will enter you into a drawing for great PRIZES!

Thank you for doing a great job!

MY FOOD DIARY

Name _____
First **Last**

PE Teacher _____

School _____

Directions:

Take this booklet to the lunch room with you.

Complete each page right **after you eat breakfast & lunch**:

1. Write down the foods & drinks you eat & how much you eat.
2. Give good details: If you had a chicken patty sandwich write "Breaded Chicken Patty Sandwich" not just "Chicken."
3. If you can not spell a word, do your best.
4. If you are absent from school, write "absent" on that page.
5. If you have questions, PLEASE ask your teacher.

Thank you!

Created for use by the H.E.R.O. Schools Study, UNCG, Department of Nutrition.

PE Worksheet

Breakfast: Monday

Write all the **foods & drinks** you have for breakfast in the correct group: SCHOOL HOME

First Name: **Last Name:** **Lunch #:**

I ate Breakfast at SCHOOL:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

I ate Breakfast at HOME:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

NOTES:

Return this booklet to your PE teacher & to enter the raffle!

PE Worksheet

Lunch: Monday

Write all the **foods & drinks** you have for lunch in the correct group:

Food Line | Vending Machines | Friends | Home

First Name: **Last Name:** **Lunch #:**

What I ate from the FOOD LINE:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

What I ate from VENDING MACHINES or FOOD CARTS:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

What I ate from my FRIENDS:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

I BROUGHT MY LUNCH from HOME & I ate:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

PE Worksheet

Breakfast: Tuesday

Write all the **foods & drinks** you have for breakfast in the correct group: SCHOOL HOME

First Name: **Last Name:** **Lunch #:**

I ate Breakfast at SCHOOL:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

I ate Breakfast at HOME:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

NOTES:

Return this booklet to your PE teacher & to enter the raffle!

PE Worksheet

Lunch: Tuesday

Write all the **foods & drinks** you have for lunch in the correct group:

Food Line | Vending Machines | Friends | Home

First Name: **Last Name:** **Lunch #:**

What I ate from the FOOD LINE:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

What I ate from VENDING MACHINES or FOOD CARTS:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

What I ate from my FRIENDS:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

I BROUGHT MY LUNCH from HOME & I ate:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

PE Worksheet

Breakfast: Wednesday

Write all the **foods & drinks** you have for breakfast in the correct group: SCHOOL HOME

First Name: **Last Name:** **Lunch #:**

I ate Breakfast at SCHOOL:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

I ate Breakfast at HOME:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

NOTES:

Return this booklet to your PE teacher & to enter the raffle!

PE Worksheet

Lunch: Wednesday

Write all the **foods & drinks** you have for lunch in the correct group:

Food Line | Vending Machines | Friends | Home

First Name: **Last Name:** **Lunch #:**

What I ate from the FOOD LINE:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

What I ate from VENDING MACHINES or FOOD CARTS:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

What I ate from my FRIENDS:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

I BROUGHT MY LUNCH from HOME & I ate:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

PE Worksheet

Breakfast: Thursday

Write all the **foods & drinks** you have for breakfast in the correct group: **SCHOOL** **HOME**

First Name: **Last Name:** **Lunch #:**

I ate Breakfast at SCHOOL:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

I ate Breakfast at HOME:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

NOTES:

Return this booklet to your PE teacher & to enter the raffle!

PE Worksheet

Lunch: Thursday

Write all the **foods & drinks** you have for lunch in the correct group:

Food Line | Vending Machines | Friends | Home

First Name: **Last Name:** **Lunch #:**

What I ate from the FOOD LINE:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

What I ate from VENDING MACHINES or FOOD CARTS:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

What I ate from my FRIENDS:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

I BROUGHT MY LUNCH from HOME & I ate:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

PE Worksheet

Breakfast: Friday

Write all the **foods & drinks** you have for breakfast in the correct group: **SCHOOL** **HOME**

First Name: **Last Name:** **Lunch #:**

I ate Breakfast at SCHOOL:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

I ate Breakfast at HOME:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

NOTES:

Return this booklet to your PE teacher & to enter the raffle!

PE Worksheet

Lunch: Friday

Write all the **foods & drinks** you have for lunch in the correct group:

Food Line | Vending Machines | Friends | Home

First Name: **Last Name:** **Lunch #:**

What I ate from the FOOD LINE:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

What I ate from VENDING MACHINES or FOOD CARTS:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

What I ate from my FRIENDS:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

I BROUGHT MY LUNCH from HOME & I ate:

FOODS	How many?	How much? (check one) All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one) All of it	Most of it	Few sips	None

SAMPLE

Complete each page after breakfast & lunch every day.
Write all the foods & drinks you eat here!

How many did you have?

How much did you have!

SIZE

How many ounces (oz.) were your drinks?

Carton Milk 8 oz.

Bottled Milk 14 or 16 oz.

Can drink 12 oz.

Juice Box 4, 6, or 8 oz.

½ PINT = 8 oz. 1 PINT = 16 oz.

PE Worksheet

Breakfast: Monday

Write all the foods & drinks you have for breakfast in the correct group: SCHOOL HOME

First Name: Cory Last Name: Miller Lunch #: 258

I ate Breakfast at SCHOOL:

FOODS	How many?	How much? (check one): All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one): All of it	Most of it	Few sips	None
Pancake Stick	1	✓				Choc. Milk	8	✓			

I ate Breakfast at HOME:

FOODS	How many?	How much? (check one): All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one): All of it	Most of it	Few sips	None
Biscuit	1		✓								

NOTES:

IF YOU HAVE COMMENTS, MAKE YOUR NOTE HERE!!!

Return this booklet to your PE teacher for credit & your free pen!

PE Worksheet

Lunch: Monday

Food Line, Vending Machines, Friends, Home

First Name: Last Name: Lunch #:

What I ate from the FOOD LINE:

FOODS	How many?	How much? (check one): All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one): All of it	Most of it	Few sips	None
Cheeseburger	1	X				Straw. Milk	8		X		
Fries	2	X				Apple Juice	4	X			

What I ate from VENDING MACHINES:

FOODS	How many?	How much? (check one): All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one): All of it	Most of it	Few sips	None
Pretzels	1			X		Fruitopia	12		X		

What I ate from my FRIENDS:

FOODS	How many?	How much? (check one): All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one): All of it	Most of it	Few sips	None
Oreos	2	X									

I BROUGHT MY LUNCH from HOME & I ate:

FOODS	How many?	How much? (check one): All of it	Most of it	Few bites	None	DRINKS	Size (oz.)	How much? (check one): All of it	Most of it	Few sips	None

Return this booklet to your PE teacher for credit & your free pen!

Created for use by the H.E.R.O. Schools Study, UNCG, Department of Nutrition.

Appendix F

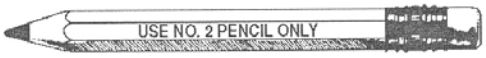
Youth/Adolescent Food Frequency Questionnaire

MARKING INSTRUCTIONS

- Use a **NO. 2 PENCIL** only.
- Do not use ink or ballpoint pen.
- Darken in the circle completely.
- Erase cleanly any marks you wish to change.
- Do not make any stray marks on this form.

The RIGHT way ● to mark your answer!

The WRONG way ⊘ ⊗ ◒ ⊙ to mark your answers!



1. What is your AGE?

- ○ Less than 9
- ○ 9
- ○ 10
- ○ 11
- ○ 12
- ○ 13
- ○ 14
- ○ 15
- ○ 16
- ○ 17
- ○ 18 or older

2. Are you:

- ○ Male
- ○ Female

3. Your Height

FEET | INCHES

4. Your Weight (lbs)

Questionnaire refers to what you ate over the past year.

5. Do you now take vitamins (like Flintstones, One-A-Day, etc.)?

○ No ○ Yes → **If yes)**

a) How many vitamin pills do you take a week?

- ○ 2 or less
- ○ 3 - 5
- ○ 6 - 9
- ○ 10 or more

b) For how many years have you been taking them?

- ○ 0 - 1 years
- ○ 2 - 4
- ○ 5 - 9
- ○ 10+ years

6. How many teaspoons of sugar do you ADD to your beverages or food each day?

- ○ None/less than 1 teaspoon per day
- ○ 1 - 2 teaspoons per day
- ○ 3 - 4 teaspoons per day
- ○ 5 or more teaspoons per day

7. Which cold breakfast cereal do you usually eat?

○ Never eat cold breakfast cereal

8. Where do you usually eat breakfast?

- ○ At home
- ○ At school
- ○ Don't eat breakfast
- ○ Other

9. How many times each week (including weekdays and weekends) do you usually eat breakfast prepared away from home?

- ○ Never or almost never
- ○ 1 - 2 times per week
- ○ 3 - 4 times per week
- ○ 5 or more times per week

SERIAL #

10. How many times each week (including weekdays and weekends) do you usually eat lunch prepared away from home?

- ○ Never or almost never
- ○ 1 - 2 times per week
- ○ 3 - 4 times per week
- ○ 5 or more times per week

11. How many times each week do you usually eat after-school snacks or foods prepared away from home?

- ○ Never or almost never
- ○ 1 - 2 times per week
- ○ 3 - 4 times per week
- ○ 5 or more times per week

12. How many times each week (weekdays and weekends) do you usually eat dinner prepared away from home?

- ○ Never or almost never
- ○ 1 - 2 times per week
- ○ 3 - 4 times per week
- ○ 5 or more times per week

13. How many times per week do you prepare dinner for yourself (and/or others in your house)?

- ○ Never or almost never
- ○ Less than once per week
- ○ 1 - 2 times per week
- ○ 3 - 4 times per week
- ○ 5 or more times per week

14. How often do you have dinner that is ready made, like frozen dinners, Spaghetti-O's, microwave meals, etc.

- ○ Never/less than once per month
- ○ 1 - 2 times per week
- ○ 3 - 4 times per week
- ○ 5 or more times per week

15. How many times each week (including weekdays and weekends) do you eat late night snacks prepared away from home?

- ○ Never/less than once per month
- ○ 1 - 2 times per week
- ○ 3 - 4 times per week
- ○ 5 or more times per week

16. How often do you eat food that is fried at home, like fried chicken?

- ○ Never/less than once per week
- ○ 1 - 3 times per week
- ○ 4 - 6 times per week
- ○ Daily

17. How often do you eat fried food away from home (like french fries, chicken nuggets)?

- ○ Never/less than once per week
- ○ 1 - 3 times per week
- ○ 4 - 6 times per week
- ○ Daily

DIETARY INTAKE

How often do you eat the following foods:

Example If you drink one can of diet soda 2 - 3 times per week, then your answer should look like this:

E1. Diet soda (1 can or glass)

- ○ Never
- ○ 1 - 3 cans per month
- ○ 1 can per week
- ● 2 - 6 cans per week
- ○ 1 can per day
- ○ 2 or more cans per day

BEVERAGES

FILL OUT ONE BUBBLE FOR EACH FOOD ITEM

18. Diet soda (1 can or glass)

- ○ Never/less than 1 per month
- ○ 1 - 3 cans per month
- ○ 1 can per week
- ○ 2 - 6 cans per week
- ○ 1 can per day
- ○ 2 or more cans per day

19. Soda - not diet (1 can or glass)

- ○ Never/less than 1 per month
- ○ 1 - 3 cans per month
- ○ 1 can per week
- ○ 2 - 6 cans per week
- ○ 1 can per day
- ○ 2 or more cans per day

20. Hawaiian Punch, lemonade, Koolaid or other non-carbonated fruit drink (1 glass)

- ○ Never/less than 1 per month
- ○ 1 - 3 glasses per month
- ○ 1 glass per week
- ○ 2 - 4 glasses per week
- ○ 5 - 6 glasses per week
- ○ 1 glass per day
- ○ 2 or more glasses per day

21. Iced Tea - sweetened (1 glass, can or bottle)

- ○ Never/less than 1 per month
- ○ 1 - 3 glasses per month
- ○ 1 - 4 glasses per week
- ○ 5 - 6 glasses per week
- ○ 1 or more glasses per day

22. Tea (1 cup)

- ○ Never/less than 1 per month
- ○ 1 - 3 cups per month
- ○ 1 - 2 cups per week
- ○ 3 - 6 cups per week
- ○ 1 or more cups per day

23. Coffee - not decaf. (1 cup)

- ○ Never/less than 1 per month
- ○ 1 - 3 cups per month
- ○ 1 - 2 cups per week
- ○ 3 - 6 cups per week
- ○ 1 or more cups per day

24. Beer (1 glass, bottle or can)

- ○ Never/less than 1 per month
- ○ 1 - 3 cans per month
- ○ 1 can per week
- ○ 2 or more cans per week

25. Wine or wine coolers (1 glass)

- ○ Never/less than 1 per month
- ○ 1 - 3 glasses per month
- ○ 1 glass per week
- ○ 2 or more glasses per week

26. Liquor, like vodka or rum (1 drink or shot)

- ○ Never/less than 1 per month
- ○ 1 - 3 drinks per month
- ○ 1 drink per week
- ○ 2 or more drinks per week

Example If you eat:

3 pats of margarine on toast
1 - 2 pats of margarine on sandwich
1 pat of margarine on vegetables

5 - 6 pats total all day

then answer this way →

E2. Margarine (1 pat) - not butter

- ○ Never
- ○ 1 - 3 pats per month
- ○ 1 pat per week
- ○ 2 - 6 pats per week
- ○ 1 pat per day
- ○ 2 - 4 pats per day
- ● 5 or more pats per day

DAIRY PRODUCTS

27. What TYPE of milk do you usually drink?

- ○ Whole milk
- ○ 2% milk
- ○ 1% milk
- ○ Skim/nonfat milk
- ○ Don't know
- ○ Don't drink milk

28. Milk (glass or with cereal)

- ○ Never/less than 1 per month
- ○ 1 glass per week or less
- ○ 2 - 6 glasses per week
- ○ 1 glass per day
- ○ 2 - 3 glasses per day
- ○ 4+ glasses per day

29. Chocolate milk (glass)

- ○ Never/less than 1 per month
- ○ 1 - 3 glasses per month
- ○ 1 glass per week
- ○ 2 - 6 glasses per week
- ○ 1 - 2 glasses per day
- ○ 3 or more glasses per day

SERIAL #

30. Instant Breakfast Drink (1 packet)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

31. Whipped cream

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

32. Yogurt (1 cup) - Not frozen

- ○ Never/less than 1 per month
- ○ 1 - 3 cups per month
- ○ 1 cup per week
- ○ 2 - 6 cups per week
- ○ 1 cup per day
- ○ 2 or more cups per day

33. Cottage or ricotta cheese

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 or more times per week

34. Cheese (1 slice)

- ○ Never/less than 1 per month
- ○ 1 - 3 slices per month
- ○ 1 slice per week
- ○ 2 - 6 slices per week
- ○ 1 slice per day
- ○ 2 or more slices per day

35. Cream cheese

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 or more times per week

36. What TYPE of yogurt, cottage cheese & dairy products (besides milk) do you use mostly?

- ○ Nonfat
- ○ Lowfat
- ○ Regular
- ○ Don't know

37. Butter (1 pat) - NOT margarine

- ○ Never/less than 1 per month
- ○ 1 - 3 pats per month
- ○ 1 pat per week
- ○ 2 - 6 pats per week
- ○ 1 pat per day
- ○ 2 - 4 pats per day
- ○ 5 or more pats per day

38. Margarine (1 pat) - NOT butter

- ○ Never/less than 1 per month
- ○ 1 - 3 pats per month
- ○ 1 pat per week
- ○ 2 - 6 pats per week
- ○ 1 pat per day
- ○ 2 - 4 pats per day
- ○ 5 or more pats per day

39. What FORM and BRAND of margarine does your family usually use?

- ○ None
- ○ Stick
- ○ Tub
- ○ Squeeze (liquid)

WHAT SPECIFIC BRAND AND TYPE (LIKE "PARKAY CORN OIL SPREAD")?

Leave blank if you don't know.

40. What TYPE of oil does your family use at home?

- ○ Canola oil
- ○ Corn oil
- ○ Safflower oil
- ○ Olive oil
- ○ Vegetable oil
- ○ Don't know

MAIN DISHES

41. Cheeseburger (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ One per week
- ○ 2 - 4 per week
- ○ 5 or more per week

42. Hamburger (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ One per week
- ○ 2 - 4 per week
- ○ 5 or more per week

43. Pizza (2 slices)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

44. Tacos/burritos (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ One per week
- ○ 2 - 4 per week
- ○ 5 or more per week

45. Which taco filling do you usually have:

- ○ Beef & beans
- ○ Beef
- ○ Chicken
- ○ Beans

46. Chicken nuggets (6)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

47. Hot dogs (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ One per week
- ○ 2 - 4 per week
- ○ 5 or more per week

48. Peanut butter sandwich (1) (plain or with jelly, fluff, etc.)

- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ One per week
- ○ 2 - 4 per week
- ○ 5 or more per week

49. Chicken or turkey sandwich (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ One per week
- ○ 2 or more per week

50. Roast beef or ham sandwich (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ One per week
- ○ 2 or more per week

51. Salami, bologna, or other deli meat sandwich (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ One per week
- ○ 2 or more per week

52. Tuna sandwich (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ One per week
- ○ 2 or more per week

53. Chicken or turkey as main dish (1 serving)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

54. Fish sticks, fish cakes or fish sandwich (1 serving)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 or more times per week

55. Fresh fish as main dish (1 serving)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

56. Beef (steak, roast) or lamb as main dish (1 serving)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

57. Pork or ham as main dish (1 serving)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

58. Meatballs or meatloaf (1 serving)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

59. Lasagna/baked ziti (1 serving)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 or more times per week

60. Macaroni and cheese (1 serving)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 or more times per week

61. Spaghetti with tomato sauce (1 serving)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

62. Eggs (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 eggs per month
- ○ One egg per week
- ○ 2 - 4 eggs per week
- ○ 5 or more eggs per week

63. Liver: beef, calf, chicken or pork (1 serving)

- ○ Never/less than 1 per month
- ○ Less than once per month
- ○ Once per month
- ○ 2 - 3 times per month
- ○ Once per week or more

64. Shrimp, lobster, scallops (1 serving)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 or more times per week

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65. French toast (2 slices)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 or more times per week

66. Grilled cheese (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 or more times per week

67. Eggrolls (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 or more times per week

MISCELLANEOUS FOODS

68. Brown gravy

- ○ Never/less than 1 per month
- ○ Once per week or less
- ○ 2 - 6 times per week
- ○ Once per day
- ○ 2 or more times per day

69. Ketchup

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

70. Clear soup (with rice, noodles, vegetables) 1 bowl

- ○ Never/less than 1 per month
- ○ 1 - 3 bowls per month
- ○ 1 bowl per week
- ○ 2 or more bowls per week

71. Cream (milk) soups or chowder (1 bowl)

- ○ Never/less than 1 per month
- ○ 1 - 3 bowls per month
- ○ 1 bowl per week
- ○ 2 - 6 bowls per week
- ○ 1 or more bowls per day

72. Mayonnaise

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 6 times per week
- ○ Once per day

73. Low calorie/fat salad dressing

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 6 times per week
- ○ Once or more per day

74. Salad dressing (not low calorie)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 6 times per week
- ○ Once or more per day

75. Salsa

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 6 times per week
- ○ Once or more per day

76. How much fat on your beef, pork, or lamb do you eat?

- ○ Eat all
- ○ Eat some
- ○ Eat none
- ○ Don't eat meat

77. When you have chicken or turkey, do you eat the skin?

- ○ Yes
- ○ No
- ○ Sometimes

BREADS & CEREALS

78. Cold breakfast cereal (1 bowl)

- ○ Never/less than 1 per month
- ○ 1 - 3 bowls per month
- ○ 1 bowl per week
- ○ 2 - 4 bowls per week
- ○ 5 - 7 bowls per week
- ○ 2 or more bowls per day

79. Hot breakfast cereal, like oatmeal, grits (1 bowl)

- ○ Never/less than 1 per month
- ○ 1 - 3 bowls per month
- ○ 1 bowl per week
- ○ 2 - 4 bowls per week
- ○ 5 - 7 bowls per week
- ○ 2 or more bowls per day

80. White bread, pita bread, or toast (1 slice)

- ○ Never/less than 1 per month
- ○ 1 slice per week or less
- ○ 2 - 4 slices per week
- ○ 5 - 7 slices per week
- ○ 2 - 3 slices per day
- ○ 4+ slices per day

81. Dark bread (1 slice)

- ○ Never/less than 1 per month
- ○ 1 slice per week or less
- ○ 2 - 4 slices per week
- ○ 5 - 7 slices per week
- ○ 2 - 3 slices per day
- ○ 4+ slices per day

82. English muffins or bagels (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ 1 per week
- ○ 2 - 4 per week
- ○ 5 or more per week

83. Muffin (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 muffins per month
- ○ 1 muffin per week
- ○ 2 - 4 muffins per week
- ○ 5 or more muffins per week

84. Cornbread (1 square)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more per week

85. Biscuit/roll (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ 1 per week
- ○ 2 - 4 per week
- ○ 5 or more per week

86. Rice

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

87. Noodles, pasta

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

88. Tortilla - no filling (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ 1 per week
- ○ 2 - 4 per week
- ○ 5 or more per week

89. Other grains, like kasha, couscous, bulgur

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 or more times per week

90. Pancakes (2) or waffles (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 or more times per week

91. French fries (large order)

- ○ Never/less than 1 per month
- ○ 1 - 3 orders per month
- ○ 1 order per week
- ○ 2 - 4 orders per week
- ○ 5 or more orders per week

92. Potatoes - baked, boiled, mashed

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

FRUITS & VEGETABLES

93. Raisins (small pack)
- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ 1 per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

94. Grapes (bunch)
- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

95. Bananas (1)
- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ 1 per week
- ○ 2 - 4 per week
- ○ 5 or more per week

96. Cantaloupe, melons (1/4 melon)
- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ 1 per week
- ○ 2 or more times per week

97. Apples (1) or applesauce
- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ 1 per week
- ○ 2 - 6 per week
- ○ 1 or more per day

98. Pears (1)
- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ 1 per week
- ○ 2 - 6 per week
- ○ 1 or more per day

99. Oranges (1), grapefruit (1/2)
- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ 1 per week
- ○ 2 - 6 per week
- ○ 1 or more per day

100. Strawberries
- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 or more times per week

101. Peaches, plums, apricots (1)
- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ 1 per week
- ○ 2 or more per week

102. Orange juice (1 glass)
- ○ Never/less than 1 per month
- ○ 1 - 3 glasses per month
- ○ 1 glass per week
- ○ 2 - 6 glasses per week
- ○ 1 glass per day
- ○ 2 or more glasses per day

103. Apple juice and other fruit juices (1 glass)
- ○ Never/less than 1 per month
- ○ 1 - 3 glasses per month
- ○ 1 glass per week
- ○ 2 - 6 glasses per week
- ○ 1 glass per day
- ○ 2 or more glasses per day

104. Tomatoes (1)
- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ 1 per week
- ○ 2 - 6 per week
- ○ 1 or more per day

105. Tomato/spaghetti sauce
- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

106. Tofu
- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

107. String beans
- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

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108. Beans/lentils/soybeans

- ○ Never/less than 1 per month
- ○ Once per week or less
- ○ 2 - 6 times per week
- ○ Once per day

109. Broccoli

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

110. Beets (not greens)

- ○ Never/less than 1 per month
- ○ Once per week or less
- ○ 2 or more times per week

111. Corn

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

112. Peas or lima beans

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

113. Mixed vegetables

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

114. Spinach

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once a week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

115. Greens/kale

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

116. Green/red peppers

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once a week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

117. Yams/sweet potatoes (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once a week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

118. Zucchini, summer squash, eggplant

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

119. Carrots, cooked

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

120. Carrots, raw

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

121. Celery

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

122. Lettuce/tossed salad

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 6 times per week
- ○ One or more per day

123. Coleslaw

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 or more times per week

124. Potato salad

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 or more times per week

Think about your usual snacks. How often do you eat each type of snack food.

Example If you eat poptarts rarely (about 6 per year) then your answer should look like this:

E3. Poptarts (1)

- ● Never/less than 1 per month
- ○ 1 - 3 per month
- ○ 1 - 6 per week
- ○ 1 or more per day

SNACK FOODS/DESSERTS

125. Fill in the number of snacks (food or drinks) eaten on school days and weekends/vacation days.

Snacks	School Days					Vacation/Weekend Days				
	NONE	1	2	3	4 OR MORE	NONE	1	2	3	4 OR MORE
Between breakfast and lunch	○	○	○	○	○	○	○	○	○	○
After lunch, before dinner	○	○	○	○	○	○	○	○	○	○
After dinner	○	○	○	○	○	○	○	○	○	○

126. Potato chips (1 small bag)

- ○ Never/less than 1 per month
- ○ 1 - 3 small bags per month
- ○ One small bag per week
- ○ 2 - 6 small bags per week
- ○ 1 or more small bags per day

127. Corn chips/Doritos (small bag)

- ○ Never/less than 1 per month
- ○ 1 - 3 small bags per month
- ○ One small bag per week
- ○ 2 - 6 small bags per week
- ○ 1 or more small bags per day

128. Nachos with cheese (1 serving)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 or more times per week

129. Popcorn (1 small bag)

- ○ Never/less than 1 per month
- ○ 1 - 3 small bags per month
- ○ 1 - 4 small bags per week
- ○ 5 or more small bags per week

130. Pretzels (1 small bag)

- ○ Never/less than 1 per month
- ○ 1 - 3 small bags per month
- ○ 1 small bags per week
- ○ 2 or more small bags per week

131. Peanuts, nuts (1 small bag)

- ○ Never/less than 1 per month
- ○ 1 - 3 small bags per month
- ○ 1 - 4 small bags per week
- ○ 5 or more small bags per week

132. Fun fruit or fruit rollups (1 pack)

- ○ Never/less than 1 per month
- ○ 1 - 3 packs per month
- ○ 1 - 4 packs per week
- ○ 5 or more packs per week

133. Graham crackers

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ 1 - 4 times per week
- ○ 5 or more times per week

134. Crackers, like saltines or wheat thins

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ 1 - 4 times per week
- ○ 5 or more times per week

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135. Poptarts (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 poptarts per month
- ○ 1 - 6 poptarts per week
- ○ 1 or more poptarts per day

136. Cake (1 slice)

- ○ Never/less than 1 per month
- ○ 1 - 3 slices per month
- ○ 1 slice per week
- ○ 2 or more slices per week

137. Snack cakes, Twinkies (1 package)

- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ Once per week
- ○ 2 - 6 per week
- ○ 1 or more per day

138. Danish, sweetrolls, pastry (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ 1 per week
- ○ 2 - 4 per week
- ○ 5 or more per week

139. Donuts (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 donuts per month
- ○ 1 donut per week
- ○ 2 - 6 donuts per week
- ○ 1 or more donuts per day

140. Cookies (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 cookies per month
- ○ 1 cookie per week
- ○ 2 - 6 cookies per week
- ○ 1 - 3 cookies per day
- ○ 4 or more cookies per day

141. Brownies (1)

- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ 1 per week
- ○ 2 - 4 per week
- ○ 5 or more per week

142. Pie (1 slice)

- ○ Never/less than 1 per month
- ○ 1 - 3 slices per month
- ○ 1 slice per week
- ○ 2 or more slices per week

143. Chocolate (1 bar or packet) like Hershey's or M & M's

- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ 1 per week
- ○ 2 - 6 per week
- ○ 1 or more per day

144. Other candy bars (Milky Way, Snickers)

- ○ Never/less than 1 per month
- ○ 1 - 3 candy bars per month
- ○ 1 candy bar per week
- ○ 2 - 4 candy bars per week
- ○ 5 or more candy bars per week

145. Other candy without chocolate (Skittles) (1 pack)

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

146. Jello

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

147. Pudding

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

148. Frozen yogurt

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

149. Ice cream

- ○ Never/less than 1 per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

150. Milkshake or frappe (1)

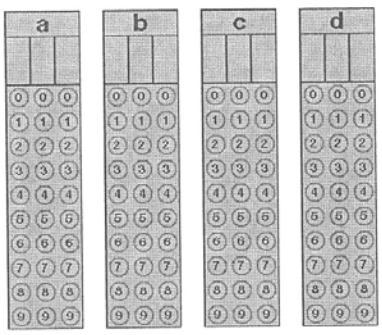
- ○ Never/less than 1 per month
- ○ 1 - 3 per month
- ○ 1 per week
- ○ 2 or more per week

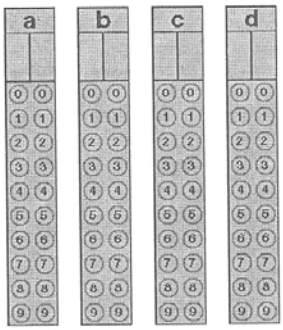
151. Popsicles

- ○ Never/less than 1 per month
- ○ 1 - 3 popsicles per month
- ○ 1 popsicle per week
- ○ 2 - 4 popsicles per week
- ○ 5 or more popsicles per week

152. Please list any other foods that you usually eat <u>at least once per week</u> that are not listed (for example, coconut, hummus, falafel, chili, plantains, mangoes, etc. . .)

FOODS	HOW OFTEN?
a) _____	a) _____
b) _____	b) _____
c) _____	c) _____
d) _____	d) _____





THANK YOU FOR COMPLETING THIS SURVEY!

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