ASSOCIATION BETWEEN BREAKFAST CONSUMPTION PATTERNS AND MICRONUTRIENT INTAKES WITH BODY MASS INDEX

A DISSERTATION

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BY

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To the Dean of the Graduate School:

I am submitting herewith a dissertation written by Lana Frantzen entitled "Association Between Breakfast Consumption Patterns And Micronutrient Intakes With Body Mass Index." I have examined this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy with a major in Nutrition.

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DEDICATION

To my parents, Dr. Simon and Helen Balvin,

who taught me the value of my education. This would not be possible without you both. I love you both with all my heart.

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ABSTRACT

LANA FRANTZEN

ASSOCIATION BETWEEN BREAKFAST CONSUMPTION PATTERNS AND MICRONUTRIENT INTAKES WITH BODY MASS INDEX

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The purposes of this study were: to determine if there was an association between the frequency of eating breakfast and body mass index (BMI) in children; to determine if there was an association between the frequency of eating ready-to-eat cereal (RTEC) and BMI in children; and to determine if there was an association between the frequency of eating RTEC and nutrient intakes of calcium, magnesium, iron, vitamin A, vitamin C, and fiber in children. Breakfast and RTEC consumption were used as predictors of the outcome variables that were BMI and nutrient intakes. The control variables were age, gender, ethnicity, energy intake, and physical fitness.

Participants included 624 students within the control group of the Bienestar Diabetes Prevention Program within the San Antonio Independent School District. At baseline, 78.2% of the participants were Hispanic, 11.9% were African American, 6.1% were White, and 3.8% were other ethnicities. These participants were interviewed at three points in time that were at the beginning of their 4th grade year then at the end of their 5th and 6th grade years.

There was no significant association between the frequency of breakfast and BMI. Among fourth-grade students, the frequency of RTEC consumption was a

significant predictor of BMI, and the intakes of calcium, magnesium, iron and vitamin C ($p < .00625$). Among fifth-grade students, the frequency of RTEC consumption was a significant predictor of intakes of calcium, magnesium, iron, vitamin A and vitamin C ($p < .00625$). Among sixth-grade students, the frequency of RTEC consumption was a significant predictor of calcium, magnesium and iron ($p < .00625$).

This present study added to the growing body of evidence that the frequency of RTEC consumption predicted a lower BMI. This present study is unique because it included a predominately Hispanic sample of children from low-income households who are at a greater risk of obesity. The promotion of a nutrient-rich breakfast that includes whole grains from RTEC with low-fat milk may be an economical way to help increase intakes of key nutrients.

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INTRODUCTION

Statement of the Research Problem

Breakfast consumption may play a favorable role in helping to stabilize or decrease body mass index (BMI) among children, adolescents and adults (Barton et al., 2005; Song, Chun, Obayashi, Cho, & Chung, 2005). Consumption of ready-to-eat cereal (RTEC) at breakfast positively impacts the intakes of some nutrients (Albertson, Anderson, Crockett, & Goebel, 2003; Barton et al., 2005; Nicklas, McQuarrie, Fastnaught, & O'Neil, 2002). However, there is a gap in the understanding of breakfast consumption and its influence on BMI as well as RTEC consumption and nutrient intakes among Hispanic children.

The Bienestar Program was developed specifically for Hispanic children with the goal of improving dietary intake and increasing physical activity. The sample for this study included children that comprised the control group in the Bienestar Program from their 4th grade through their 6th grade years. The purposes of this study were to (a) examine the relationship of frequency of breakfast consumption and BMI, (b) examine the relationship of frequency of RTEC consumption and BMI, (c) examine the relationship of frequency of RTEC and nutrient intakes among a predominately Hispanic sample of children.

Rationale for the Study

The population of interest in this study is Hispanic children. The Hispanic population is the largest minority group in the U.S. reaching 44.3 million or 14.8% of the total U.S. population (United States Census Bureau, 2006). The majority of Hispanic households (64%) are Mexican American (United States Census Bureau, 2005). Unfortunately, minority populations such as the Hispanic population are at a greater risk of being overweight. Approximately 40% of Mexican American children from 6 to 11 years of age are either overweight or at risk of becoming overweight versus 36% of non-Hispanic African American and 26% of non-Hispanic White children (Hedley et al., 2004). The prevalence of overweight among Texas children was 22.4% for 4th grade students, 19.2% for 8th grade students, and 15.5% for 11th grade students; the highest prevalence was among Hispanic boys (31.1% in the 4th grade, 32.6% in the 8th grade, and 29.5% in the 11th grade) and 4th grade Hispanic girls (26.7%; Hoelscher et al., 2004). Results of a compilation of nine epidemiological studies, including NHANES II and III, using data from 66,772 children aged 5-17 years indicated that the greatest percentage of overweight children was among Hispanic boys, African American girls and Hispanic girls (Rosner, Prineas, Loggie, & Daniels, 1998). Overweight is also a contributing factor to serious health problems such as type 2 diabetes among children (American Diabetes Association, 2007).

Overweight is a multifactorial condition; however, poor dietary intake is a significant contributing factor. The dietary intakes of the Hispanic population tend to be deficient in essential nutrients (Wiecha, Fink, Wiecha, & Hebert, 2001). Breakfast consumption has been related positively to BMI and the consumption of RTEC has been associated positively with improved nutrient intakes. These eating patterns may contribute positively to lifestyle factors such as daily breakfast consumption that may be promoted among Hispanic children. This study explored the relationships between breakfast and RTEC consumption, BMI, and nutrient intakes among a predominately Hispanic sample of children.

Objectives

The objectives of the study were:

1. to determine if there was an association between the frequency of eating breakfast and BMI in children;
2. to determine if there was an association between the frequency of eating RTEC and BMI in children; and
3. to determine if there was an association between the frequency of eating RTEC and nutrient intakes of calcium, magnesium, iron, vitamin A, vitamin C, and fiber in children.

Null Hypotheses

The study had the following null hypotheses:

1. The frequency of eating breakfast will have no significant association with BMI among students in the control group of the Bienestar Program controlling for age, gender, ethnicity, energy intake, and physical fitness at their 4^{th}, 5^{th}, and 6^{th} grade years.

2. The frequency of eating RTEC will have no significant association with BMI among students in the control group of the Bienestar Program controlling for age, gender, ethnicity, energy intake, and physical fitness at their 4^{th}, 5^{th}, and 6^{th} grade years.
3. The frequency of eating RTEC will have no significant association with nutrient intakes of calcium, magnesium, iron, vitamin A, vitamin C, and fiber among students in the control group of the Bienestar Program controlling for age, gender, ethnicity, energy intake, and physical fitness at their 4^{th}, 5^{th}, and 6^{th} grade years.

Definitions

Breakfast:

> The use of a time-derived definition of breakfast introduces potential biases, for it does not capture all occasions defined as breakfast in the time periods for which we have meal designations, nor does it exclude other eating occasions respondents named in the same time period. (Siega-Riz, Popkin, & Carson, 1998)

For the purpose of this study, breakfast was considered the first meal of the day consisting of any solid food, beverages, or both eaten in the morning, named by the respondent as "breakfast" (Centers for Disease Control and Prevention, 2002)

Hispanic: The United States Census Bureau (2000) defines Hispanic or Latino as those people who classified themselves as Mexican American, Chicano, Puerto Rican, Cuban or any other origin from Spain or the Spanish-speaking countries of Central or South America, or the Dominican Republic.

Ready-to-eat cereal (RTEC): A cereal that is processed to the point that it can be eaten without additional preparation such as in boxed cereal (Intota, 2008).

Ready-to-eat cereal (RTEC) breakfast: Participant defined their breakfast as consisting of a RTEC.

Non-ready-to-eat (RTEC) breakfast: Participant defined their breakfast as consisting of foods other than RTEC.

Ready-to-eat cereal (RTEC) day: Participant defined their daily dietary intake including RTEC.

Non-ready-to-eat cereal (RTEC) day: Participant defined their daily dietary intake without consumption of RTEC.

CHAPTER II

REVIEW OF LITERATURE

The United States has witnessed a growing epidemic of overweight children. According to the Institute of Medicine (IOM), over the past three decades the prevalence of overweight children has more than doubled for preschool children aged 2-5 years and adolescents aged 12-19 years and tripled for children aged 6-11 years (IOM, 2004). Approximately 70% of obese (BMI-for-age $\geq 95^{th}$-percentile) adolescents become obese adults (Parsons, Power, Logan, & Summerbell, 1999). Unfortunately, children who are overweight are also at an increased risk of developing type 2 diabetes, a disease that once was considered an adult-onset disease. Type 2 diabetes accounted for 8-45% of all new pediatric cases in the 1990s compared to less than 4% prior to the 1990s (IOM, 2004). Ethnic minority populations, particularly Hispanic children, are considered to be at higher risk of becoming overweight and developing type 2 diabetes (IOM, 2004). Hispanic children have more risk factors for type 2 diabetes such as a higher BMI than non-Hispanic children (Strauss & Pollack, 2001). The causes of why Hispanic children are overweight are a combination of biological, economic, and social factors such as poor nutrition. The family dinner table may be one contributor and also an avenue for behavioral change (Strauss & Pollack, 2001). There is a gap in the research on breakfast consumption, BMI, and nutrient intakes among Hispanic children.

This review of literature will provide a definition of overweight and obesity in children, an overview of the scope of the problem, school-based programs created to address health promotion among children, dietary patterns of Hispanics and the potential barriers to reaching adequate intake of nutrients, breakfast consumption and how it relates to BMI, and ready-to-eat (RTEC) consumption and how it relates to BMI and nutrient intakes.

Definition of Overweight and Obesity in Children

There is no world-wide consensus on the definition of overweight or obesity in children and adolescents. The definition of childhood obesity is different depending on what organization defines it. The World Health Organization (WHO) uses BMI as an indirect measure of body fat that is calculated as a ratio of body weight in kilograms to the square of height in meters (kg/m^2). WHO (2006) considers overweight as a BMI equal to or greater than 25 and obesity as a BMI equal to or greater than 30 for adults. Children and adolescents have BMI values based on growth charts for age and gender that is referred to as BMI-for-age. According to the CDC, obese is defined as a child with a BMI-for-age that is equal to or greater than the 95^{th} percentile. A child is overweight with a BMI-for-age that is above the 85^{th} and less than the 95^{th} percentile. BMI is calculated and interpreted differently from adults because the amount of body fat changes with age in children and the amount of body fat differs between boys and girls (CDC, 2006). The CDC and American Academy of Pediatrics (2006) recommend BMI be used as a screening tool and not a diagnostic tool to identify overweight children beginning at two years of age through nineteen years. If a child has a high BMI for his age, then further assessment such as skin-fold thickness measurements should be performed to determine if the child has excess fat. The IOM (2004) defines childhood obesity as children and adolescents between the ages of 2 through 18 years who have a BMI equal to or greater than the 95th percentile for age and gender as indicated by the CDC BMI charts. European researchers consider overweight as at or above the 85th percentile to the 95th percentile and at or above the 95th percentile of BMI is obese (Flodmark, Lissau, Moreno, Pietrobelli, & Widhalm, 2004). In April 2006, the WHO presented BMI charts for infants and children up to five years of age. The WHO is currently developing an international growth reference for school-age children and adolescents.

The CDC BMI chart guidelines for obese and overweight will be considered the appropriate standard. According to the CDC, an obese child is defined as at or above the 95th percentile BMI-for-age and a child is overweight with a BMI-for-age that is above the 85th and less than the 95th percentile.

Scope of the Problem

The prevalence of overweight children has increased significantly according to several national surveys. In the United States, there are approximately nine million children over six years of age who are considered obese (BMI-for-age ≥ 95th percentile; IOM, 2004). There has been an increase in the prevalence of obesity among all age groups of children and adolescents as documented in NHANES I 1971-1975 through NHANES 2003-2004. Among preschool-aged children (2-5 years), the prevalence of obesity increased from 5.0% to 13.9%. Among school-aged children (6-11 years), the prevalence increased from 4.0% to 18.8%. And among school-aged adolescents (12-19 years), the increase was 6.1% to 17.4% (Ogden, Carroll, et al., 2006; Ogden, Flegal, et al., 2002).

Unfortunately, minority populations are at a greater risk of being obese. Approximately 40% of Mexican American children from 6 to 11 years of age are either obese or overweight versus 36% of non-Hispanic African American and 26% of non-Hispanic White children (Hedley, Ogden, Johnson, Carroll, Curtin, & Flegal, 2004). The highest percentage of obesity among 66,772 children aged 5-17 years was among Hispanic boys and African American and Hispanic girls (Rosner, Prineas, Loggie, & Daniels, 1998).

Socioeconomic status may also play a role in the likelihood of a child being overweight. The prevalence of overweight preschool children from low-income families has increased from 18.6% in 1983 to 21.6% in 1995 based on the 85th percentile cutoff point for weight-for-height, and from 8.5% to 10.2% for the same period based on the 95th percentile cutoff point (Mei et al., 1998). Overweight children were more likely to be Hispanic and live in households with incomes below 150% of the Federal poverty level. The cost and accessibility of healthy foods in low income communities and unsafe neighborhoods have been reported as specific ways that poverty impacts body weight (Lutfiyya, Garcia, Dankwa, Young, & Lipsky, 2008).

The rates of overweight in Texas schoolchildren are among the highest in the country. A sample of 6,630 children attending public schools in Texas, weighted to represent 4^{th}, 8^{th}, and 11^{th} grades, was assessed for BMI. The prevalence of overweight was highest among Hispanic boys (29.5% - 32.6%), 4th-grade Hispanic girls (26.7%), and 4th-grade (30.8%) and 8th-grade (23.1%) African American girls (Hoelscher et al., 2004).

Childhood overweight tracks into adulthood with subsequent increased risk of premature death and disability in adulthood (WHO, 2006). Overweight in children and adolescents is a serious health issue that may contribute to increased blood pressure, increased blood cholesterol concentration, and development of type 2 diabetes. Almost 60% of overweight children had at least one cardiovascular disease risk factor such as elevated cholesterol, triglycerides, insulin or blood pressure, and 25% had two or more risk factors in a population-based sample of 5-10 year-old children.

Recent studies have linked overweight and the development of type 2 diabetes in children especially among minorities (IOM, 2004; Rosenbloom, Joe, Young, & Winter, 1999). In a study of 55 Hispanic youth assessed for frequency and clinical features of type 2 diabetes, 17 (31%) of the youth had type 2 diabetes and all were classified as "obese" (mean BMI= 32.9 ± 6.2 kg/m²); 62% had no ketonuria, and fasting C-peptide levels were elevated (4.28 ± 3.43 ng/ml). Genetics may also play a role in the development of diabetes. Genetic susceptibility to type 2 diabetes when present with overweight can result type 2 diabetes in Mexican American children (Neufeld, Raffel, Landon, Chen, & Vadheim, 1998).

Many factors contribute to obesity in children. The role of genetics and environment have not been adequately separated and defined. The "Viva La Familia Study" explored the genetic mapping of overweight children and its comorbidities in the Hispanic population. The sample included 1,030 children from 319 families with an overweight proband between 4 and 19 years of age. The proband was selected on the basis of BMI and fat mass. A strong family history of obesity, diabetes, cardiovascular disease, and hypertension in the parents or grandparents was indicated. Sex, age, and environmental covariates accounted for 1-91% of the phenotypic variance, respectively. Heritability coefficient is the "statistic that estimates the genetic effect size...heritability is the proportion of phenotypic variance that can be accounted for by genetic differences among individuals" (Joseph, 2004). An example would be height; correlations for first-degree relatives are about .45 on average, whether raised together or apart. Identical and fraternal twin correlations are .90 and .45, respectively, regardless of whether they are raised together or apart. These results show significant genetic effects with heritability estimated as 90% (Plomin, 1994). Within the "Viva La Familia Study," heritabilities of the anthropometric traits ranged from 0.24 to 0.75. Heritability coefficients for body composition ranged from 0.18 to 0.35. Diet and physical activity indicated heritabilities of 0.32 to 0.69. Metabolic disease risk was heritable with coefficients from 0.25 to 0.73. This study offers evidence of strong genetic influence to the prevalence of overweight and its comorbidities in Hispanic children (Butte, Cai, Cole, & Comuzzie, 2006). Obesity is a multifactorial condition and genetics as well as the environment may contribute to its development.

Prevention of obesity is easier, less costly and more effective than treating obesity once it is fully developed (International Obesity Task Force, 1999). The two factors that can be manipulated in favor of an appropriate BMI-for-age percentile are physical activity and dietary intake. The basis for the current understanding of childhood overweight treatment was derived from long-term studies carried out by L.H. Epstein (1996) which involved tracking children aged 6-12 years from 143 families over a ten-year period. The intervention approach with these components was used: counseling sessions for both parent and child that varied from 8-26 weeks; the "stoplight" diet that included foods categorized as green-low calorie, yellow-moderate calorie or red-high calorie; and physical activity. The main findings were that a child's outcome was superior when both parents and children received instruction on behavior modification; these children showed significantly greater decreases in percent overweight after 5 and 10 years (-11.2% and -7.5%, respectively) than children in the control group (+7.9% and +14.3%, respectively) (Epstein, Myers, Raynor, & Saelens, 1998; Epstein, Valoski, Wing, & McCurley, 1990).

Review of Health Promotion Programs for Children

Numerous school-based prevention programs have been implemented to address the growing problem of overweight children. Since 95% of American children attend school; schools are a logical mode of implementing an overweight prevention program that may influence the food and physical activity environments of children (Brown, 1997; Dehghan, Akhtar-Danesh, & Merchant, 2005). Components of a successful school-based intervention model include health curriculum, physical education classes, social support services, school-site health promotion for faculty and staff, child's family linked to community health promotion efforts, school environment, health services and school food service (Story, 1999). The health curriculum should include: benefits, social influences and components of healthy eating and physical fitness; healthy weight management; body size acceptance; individualized physical activity programs; self-monitoring and goal-setting. Physical education classes should incorporate health-related physical activities that are enjoyable to children of all sizes and abilities. Counseling provides assistance for those with disordered and emotional eating and self-esteem issues. Health promotion for faculty and staff includes healthy eating, participation in physical activity, and weight management role-modeling. The links between family and community are take-home activities and school-based events. The nutrition environment of schools includes vending machine options and school stores, fund-raising, classroom snacks/parties and in-school advertising of foods. Health services would offer overweight screening, preventive counseling, weight management treatment or referral. School food service could provide healthy school meals and snacks (Story, 1999). The dynamic of these interacting components may promote the best results for students.

Several school-based programs have focused on improving dietary intakes by increasing fruit and vegetable consumption. The "Bienestar Health Program" is an example of a program designed to reduce risk factors related to type 2 diabetes among Hispanic children in San Antonio, Texas. The objective of the program was to reinforce "Bienestar" healthy behaviors. These behaviors included decreasing dietary saturated fats and sugars, increasing fruits, vegetables and whole grains, decreasing TV viewing, and increasing physical activity. The program included the following components: classroom curriculum, family program, school cafeteria program, and after-school health club. The program used a randomized controlled design with an intervention group and control group. Eighty percent of participants were Mexican American and 94% were from households considered economically-disadvantaged. Three twenty-four dietary recalls (two weekdays and one weekend day) were collected. Results indicated a significant increase in dietary fiber intake (approximately 1 gram per day; $p < .009$) among children in the intervention group and decreased fiber intake for children in the control group (Trevino, Yin, Hernandez, Hale, Garcia, & Mobley, 2004).

A study with similar program components to Bienestar was implemented in ten primary schools. The program was called "APPLES" for "Active Program Promoting Lifestyle in Schools" and was based in England. The program consisted of teacher training, school meal modifications, development and implementation of school action plans to promote healthy eating and physical activity over one academic year (September 1996-July 1997). The program used a population approach targeting the whole school community including parents, teachers, and school food service staff. The sample included 636 children (n=314 experimental and n=322 control) with mean age of 8.4 ± 0.63 years for both groups. Anthropometric data, 24-hour recalls of diet and physical activity, and three-day diaries of diet and physical activity were collected at baseline and follow-up. The program was successful in increasing the average vegetable intake by one-third portion more per day. According to the 3-day diet diaries that had a lower completion rate than the 24-hour diet recalls (experimental 63%, control 64% versus experimental 92%, control 91%, respectively), there was a higher intake of high-sugar foods and drinks in overweight children than in the experimental group. There was no significant difference in physical activity or sedentary behaviors for the sample as a whole regardless of experimental or control group status. The researchers stated that the program might have been strengthened if the families had been targeted more directly without losing the focus of the school community (Sahota et al., 2001).

American Indian children, like Hispanic children, are at an increased risk of becoming overweight and developing type 2 diabetes. Therefore, several programs have been created to specifically address the needs of this population. "Pathways" is a school-based, multicomponent intervention for reducing percent body fat in American Indian children. The sample included 1,704 children in 41 schools over three consecutive years from 3rd to 5th grades randomly assigned to either experimental or control groups. The intervention had four components: (a) change in dietary intake including school food service involvement, (b) increase in physical activity, (c) classroom curriculum focused on healthy eating and lifestyle, and (d) family involvement. Dietary intake was assessed using direct observation at lunch times and 24-hour diet recall. The children in the intervention schools showed a significant reduction in the percentage of energy from fat than the children in the control schools (31.1% compared with 33.6%, respectively; $p < .001$). However, there was no significant reduction in percentage body fat in either the experimental or control groups (Caballero et al., 2003).

The Kahnawake School Diabetes Prevention Project targeted elementary-school Mohawk Indian children in Canada. The researchers determined the impact of the community-based intervention program on body size, physical activity, and dietary intake from 1994-2002. The main program components included (a) health education on nutrition and physical activity, (b) community activities with family involvement, and (c) school nutrition policy. Skin-fold thickness was reduced but not BMI. Physical activity or fitness were not reduced either. The intake of high-fat and high-sugar foods significantly decreased from 1996 onward, with 65-75% reduction in the consumption of these foods in 2002; however, the consumption of fruits and vegetables decreased also (Paradis et al., 2005).

The Sandy Lake Health and Diabetes Project was a school-based program designed to test the hypothesis that after one year, a culturally appropriate intervention would increase students' knowledge, skills, and self-efficacy and positively alter behaviors related to diet and exercise among American Indian children. The four main program components were (a) classroom curriculum; (b) family involvement; (c) peer involvement; and (d) environmental school support. The family involvement included using radio show messages, information booths at parent-teacher nights, and letters sent home. Examples of peer involvement were via video cooking club featuring students making and enjoying fruit and vegetable snacks and "Diabetes Kids" radio show on weekly youth radio program. Environmental school support included policy to ban high-fat and high-sugar snack foods at school and a healthy school meal program The sample included 122 children in 3rd (40%), 4th (37%), and 5th grades (23%). At baseline, 32% of both boys and girls were obese (at or above the 95th-percentile). Increased exposure to the intervention was significantly associated with meeting the "age plus 5 grams of fiber per day" recommendation among children 7 and 14 years of age. An example of meeting this goal would be a 10-year-old child consuming 15 grams of fiber daily. The breakfast snack program, an environmental strategy at school, provided students with healthy food choices typically one serving of 1% milk, fruit such as an apple, cheese, and a rice cake.

Participation in the breakfast program was a reliable daily source of fruit for children from kindergarten through the 5th grade. A significant decrease in percentage of energy from dietary fat (34% to 32%) was not associated with the intervention. This change may have been due to environmental changes in the school and at home that the intervention variable did not capture. Overall, 32% of students met the dietary guideline of ≤ 30% energy from dietary fat at baseline, and 41% met the recommendation at follow-up. There were significant increases ($p < 0.0001$) in dietary intention, dietary preference, knowledge, and dietary self-efficacy, and in the curriculum knowledge scale between baseline and follow-up. The program improved knowledge and the psychosocial factors related to healthy eating and dietary fiber intake of students in a remote First Nations community (Saksvig et al., 2005).

African American children have participated in school-based interventions to address the increasing prevalence of overweight in that population. A twelve-week after-school program for African American children was designed to promote healthy diets and exercise. The sample included 56 children (18 male, 38 female; age 11.1 ± 1.3 years) and 25 parents/guardians who completed the program. Children and their parents/guardians had an increase in consumption of fruits (mean fruit intake for children preintervention= 4.45 ± 1.99 and postintervention= 5.64 ± 2.43 [$p < .01$]; adults preintervention= 4.16 ± 1.82 and postintervention= 5.12 ± 2.16 [$p < .01$] on 1-10 scale, with 2= 1 to 3 times per month, 3= 1 to 2 times per week, 4= 3 to 4 times per week and 5= 5 to 6 times per week) and a reduction in diastolic blood pressure ($p < .05$). Children showed significant increases in consumption of 100% fruit juice (pre= 3.94 ± 2.11; post= 4.83 ± 2.37 [p<

.05]), salad (pre= 3.94 ± 1.97; post= 4.58 ± 2.80 [p< .01]) and non-fried potatoes (pre= 2.79 ± 1.66; post= 3.70 ± 2.33 [p< .01]). Parents/guardians had a decrease in body fat, BMI, and an increase in endurance walk/run time (p< .05). The overall results showed that children tended to gain more diet-related benefits while parents/guardians achieved more fitness-related benefits (Engels, Gretebeck, Gretebeck, & Jimenez, 2005).

A program in Massachusetts called "Planet Health" specifically addressed overweight female students. Obesity was defined by the authors as a composite indicator based on both BMI and a triceps skin-fold value greater than or equal to age- and gender-specific 85th percentile reference data. A sample of 1,295 ethnically diverse 6th and 7th grade children participated in this school-based interdisciplinary randomized, controlled intervention over two school years. The intervention focused on four health behaviors: reducing television viewing to less than two hours per day, increasing moderate and vigorous physical activity, decreasing consumption of high-fat foods, and increasing consumption of fruits and vegetables to five or more servings a day. The prevalence of obesity among female students in the control schools increased from 21.5% to 23.7% over the two school year intervention periods and during the same time period obesity prevalence declined from 23.6% to 20.3% for female participants in the intervention school. After controlling for baseline covariates, obesity prevalence among the female participants in the intervention schools was significantly reduced compared with females in control schools (odds ratio [OR], 0.47; 95% confidence interval [CI], 0.24-0.93; p= .03). Among the female students, there was an increase in fruit and vegetable intake (0.32 servings/day; 95% CI, 0.14-0.50 servings/day; p= .003). "Planet Health" significantly decreased the prevalence of obesity only among the female participants in the experimental group (Gortmaker, Peterson, et al., 1999).

Another successful two-year program was "Eat Well and Keep Moving" for 4^{th} and 5^{th} grade children who were predominantly African American. The intervention focused on decreasing intake of foods high in total fat and saturated fat and increasing intake of fruits and vegetables while reducing television viewing and promoting physical activity. Twenty-four hour dietary recalls indicated reductions in percentages of total energy from fat and saturated fat among the intervention children versus the control children (-1.4%; 95% CI, -2.8 to -0.04; p= .04 and -0.60%; 95% CI, -1.2 to -0.01; p= .05). Participants in the intervention group had an increase in their intake of fruits and vegetables (0.36 servings/4,184 kJ; 95% CI, 0.10-0.62; p= .01), vitamin C intake (8.8 mg/4,184 kJ; 95% CI, 2.0-16; p= .01), and fiber intake (0.7 g/4,184 kJ; 95% CI, 0.0-1.4; p= .05). Overall, this program improved dietary intakes and reduced time spent viewing television (Gortmaker, Cheung, et al., 1999).

All these programs integrated nutrition and physical activity components. However, another study examined the impact of nutrition versus exercise and then both nutrition and exercise combined. Three intervention programs were implemented for overweight prevention in 5-7 year old children. There was a control group and three intervention groups that were as follows: (a) nutrition, (b) physical activity, and (c) combined nutrition and physical activity intervention. The duration of the program was fourteen months among a sample of 213 children. The interventions included lunch-time clubs that shared nutrition and/or physical activity curriculums. Overall among all groups, the intake of fruits ($p < .01$) and vegetables ($p < .05$) increased significantly. Fruit intake increased significantly in the nutrition group ($p < .05$) and the control group ($p < .05$) (Warren, Henry, Lightowler, Bradshaw, & Perwaiz, 2003).

The common denominator among these programs is they are all school-based approaches (Table 1). School-based programs have potential to positively alter children's risk of becoming overweight especially if they include behavioral strategies, parental involvement, and on-going professional supervision and monitoring (Brown, 1997). Noteworthy changes have been observed in health behaviors within one year after a combination of school- and family-based intervention as seen in the Kiel Obesity Prevention Study (Muller, Asbeck, Mast, Langnase, & Grund, 2001).

Family-based intervention models have shown successful results. One such model evaluated the effect of a parent-focused behavioral intervention on parent and child eating habits. The intervention was a comprehensive behavioral weight-control program that encouraged an increase in fruit and vegetable intake and a decrease in intake of high-fat/high-sugar foods. Over a one-year period, treatment influenced eating behaviors by increasing fruit and vegetable intake while decreasing intake of high-fat/high-sugar foods (Epstein, Gordy, et al., 2001). However, the combination of both family- and school-based models may have a synergistic effect.

Table 1

Comparison of Several School-Based Children Health Promotion Programs

Program Sample of Children	Age in years (±SD) or Grade Level	Length of Program	Dietary Results
Treviño (2004) 1,221 Mexican American	9.79 (±0.53)	7 months	↑ dietary fiber
Sahota (2001) 636 English	8.4 (± 0.63)	1 year	↑ vegetable intake serving, 1/3 portion more per day
Caballero (2003) 1,704 American Indian	7.6 (± 0.6)	3 years	↓ % of energy from fat
Paradis (2005) 1,320 Canadian Indian	1st-6th grade	3 years	↓ intake of high-fat and high-sugar foods; ↓ intake fruit & vegetable
Saksvig (2005) 122 Canadian Indian	7-14	1 year	↑ dietary fiber
Engels (2005) 56 African American	11.1 (±1.3)	12 weeks	↑ intake of fruits, salad, fruit juice, non-fried potatoes
Gortmaker, Cheung, et al. (1999) 1,295 diverse	11.7 (±0.7)	2 years	↑ intake of fruit & vegetable among females
Gortmaker, Peterson, et al. (1999) 2,103 Majority African American	4th-5th grade	2 years	↓ % total energy from fat and saturated fat; ↑ intake of fruit & vegetable; ↑ intake vitamin C & fiber
Warren (2003) 213 English	6.1 (±0.6)	14 months	↑ intake of fruit

Dietary Patterns of the Hispanic Population and Potential Barriers to Reaching Adequate Dietary Intakes

Hispanic dietary patterns are unique in some aspects; however, intakes may also be very typical of American diets. A comparison of dietary patterns among Hispanic (n=545), African American (n=263), White (n=1,615), and Vietnamese (n=226) adolescents was investigated in Massachusetts with the majority of the sample aged 12-18 years. The sample included a disproportionate number of White adolescents that was not mentioned by the researchers as a limitation. A food frequency survey was used that asked, "how often do you eat fruit?," "how often do you eat vegetables (like lettuce, green beans, cabbage, broccoli, carrots)?," and "how often do you eat dairy foods (like milk, cheese, ice cream, yogurt)?" Daily fruit intake was highest among Vietnamese adolescents with 1.68 servings/day and lowest among African American students with 1.12 servings/day. Vegetable intake was highest among Vietnamese adolescents (1.43 servings/day) and lowest among Hispanic adolescents (0.93 serving/day). Dairy food intake was highest among White adolescents and lowest among Vietnamese students. Hispanic adolescents were slightly less than White adolescents as a percentage of those who got three or more servings of dairy a day (27.2% and 27.4%, respectively). Hispanic students were most likely not to eat five or more servings of fruits and vegetables a day (10.8%) versus African American students (11.1%) and White students (15.1%) (Wiecha, Fink, Wiecha, & Hebert, 2001).

The increased fruit and vegetable intake among White students versus African American and Hispanic students was supported by Dubowitz et al. (2008) using food frequency data from the Third National Health and Nutrition Examination Survey. White students had a significantly greater intake of fruits and vegetables (4.90 servings/day ± 3.53) than African American students (3.99 servings/day ± 3.38) or Mexican American students (4.57 servings/day ± 3.40). The socioeconomic status (SES) of the neighborhood had a positive association with fruit and vegetable intake; one standard deviation increase in the neighborhood SES index was related to almost two additional servings of fruits and vegetables per week.

The Multiethnic Cohort investigated adherence to the Food Guide Pyramid recommendations among Latinos and African Americans adults. The sample included Latinos born in Mexico, South or Central America and those born in the U.S. The majority of the sample born outside of the U.S. was born in Mexico (74%). Latinos born outside the U.S. had greater intakes of fruits, vegetables, grains, and legumes than Latinos born in the U.S. Most grains consumed were non-whole grains across all Latino groups. All Latinos consumed tomatoes as a main vegetable and milk was the main dairy food. The main sources of protein were meat, poultry, and legumes. Latinos born outside the U.S. were most likely to follow the dietary recommendations; however, they would still benefit from interventions created for nutrition education (Sharma et al., 2004). The longer Hispanic individuals have been living in the U.S. then the more likely they are to have macronutrient profiles similar to those of non-Hispanic Whites (Bermudez, Falcon, & Tucker, 2000).

A sample of Mexican immigrants (n=735) living in Washington state had similar tendencies compared to non-Hispanic White residents. Dietary patterns were variable according to ethnicity and level of acculturation. Hispanic residents consumed one more daily serving of fruits and vegetables ($p<0.001$) compared to non-Hispanic Whites. As Hispanic residents became more acculturated, their dietary intakes changed as well. Acculturation was determined using a scale that included questions about language most often spoken and most often used for thought, ethnic identification of self, and birthplace of self. Highly acculturated Hispanic residents consumed fewer daily servings of fruits and vegetables versus less acculturated Hispanic residents ($p<0.05$). Hispanic residents did not regularly opt for skim milk or low-fat choices from fast-food restaurants regardless of their level of acculturation. An early dietary change for Hispanic residents as they became more acculturated was adding fat such as butter at the table to foods such as bread and potatoes. The greater intake of fruits and vegetables and not adding fat to bread and potatoes are dietary habits that are beneficial to preserve to provide more vitamins, minerals, fiber and decrease fat intake (Neuhouser, Thompson, Coronado, & Solomon, 2004). A relationship between the degree of acculturation and dietary intake, such as fruit and vegetable intake, has been established among the Hispanic population.

An examination of restaurant and food-shopping preferences among Latino women (n=357) and their families in border communities in Southern California provided valuable insight. Family habits were assessed such as frequency of eating outside the home, primary restaurant and food store choices, use of discount/bulk-purchase stores, and alternative sources of fruits and vegetables in their community. The more acculturated women, meaning those who lived in the U.S. longer, ate at fast-food restaurants more frequently. These women preferred fast-food restaurants for their cost, convenient location and child-friendly policies, and they did not understand the potentially negative influence on their health or the detriment to not adopting more healthful dietary habits. The more acculturated women ate outside the home more often for lunch and dinner than less acculturated women. Less acculturated women chose to shop in grocery stores with fewer healthy choices. It is possible that less acculturated women chose to shop at these stores due to perceived language barriers or unavailability of certain ethnic foods at larger supermarkets. There is a strong relationship between acculturation and dietary behaviors. Acculturated women and their families would benefit from focused information on healthy restaurant options while less acculturated women may better utilize instrumental support interventions such as guided tours of large supermarkets that they would not normally visit (Ayala, Mueller, Lopez-Madurga, Campbell, & Elder, 2005).

A tracking study of nutrients related to cardiovascular health, such as dietary energy, fat, and sodium, followed Mexican American and non-Hispanic White children between the ages of 4 and 12 years. Families were recruited from 63 state-funded preschools, children's centers, and Head Start centers. Energy intake was maintained at ~1,300 kcal/day among children 4-7 years when it would be anticipated to increase during this period of time. Mothers were less accurate in detailing their children's dietary intake at school or at other non-parental locations as the child grew older. However, none of the variables were significant. Dietary intake, specifically energy, fat, and sodium, did not change significantly across short periods of time from preschool to early elementary years and then again from 11-12 years. Better tracking at younger years may be due to the mother's perception of her child's dietary intake and diet is more supervised by parents at younger ages than for preadolescents. Preadolescents are most influenced by their peers instead of their parents (Zive, Berry, Sallis, Frank, & Nader, 2002).

Food security may also play a role in the relationship between food-related parenting attitudes and Mexican American children's food intake. Households that were food-insecure had mothers concerned about their ability to provide sufficient food for their families. These mothers perceived the priority of healthful food being the quantity of food available instead of the quality. Mothers of food-secure households had the perception of making healthful foods available and were positively associated with children's fruit intake and negatively associated with percentage of energy from fat (Matheson, Robinson, Varady, & Killen, 2006).

Clearly defining an all-inclusive typical Hispanic dietary pattern is difficult. There are numerous considerations such as age group, level of acculturation, and socio-economic status that influence dietary patterns. Previous studies provide background information on the growing Hispanic population dietary intake and trends to be considered for future research.

Health promotion programs specifically for overweight prevention among Hispanic children from immigrant families should ideally be initiated at a young age and customized for the level of acculturation. Minority families may also have financial and cultural limitations. Therefore, cultural sensitivity to their needs and provision of effective and realistic methods such as managing food costs, variety, and convenience are particularly useful (Wang & Tussing, 2004).

Health promotion objectives among Hispanic children need to target the behaviors that will be successful in long-term overweight prevention. The specific dietary patterns to achieve this goal are not clear and need further investigation. However, an interesting association to investigate further is breakfast and RTEC consumption.

Breakfast Consumption as It Relates to BMI

Dietary patterns may provide insight to health-promoting behaviors that should be encouraged to help prevent children from becoming overweight. One of these dietary patterns is breakfast consumption as it relates to BMI. Breakfast has been called "the most important meal of the day." A review of the science will help substantiate that claim, determine consumption patterns, and provide insight as it relates to BMI. The impact of breakfast, specifically consumption of RTEC, will be examined to define the role of breakfast food choice on BMI and nutrient intakes.

Breakfast skipping is prevalent in the United States ranging from 10-30% depending on the age group, population, and definition of breakfast (General Mills Bell Institute of Health and Nutrition, 2007). Siega-Riz, Popkin, and Carson (1998) examined breakfast consumption in preschoolers, 8 to 10-year-old children, and adolescents between 1965 and 1991. Breakfast consumption declined 5%, 9%, and 13-20% among each group, respectively. Breakfast skipping among different age groups was 1- to 7-year-olds -8% of the time; 8- to 10-year-olds -12% of the time; 11- to 14-year-olds -20%; and 15- to 18-year-olds -30% of the time. Miller, Forgac, Cline, and McBean (1998) observed a 21% rate of breakfast skipping among 8- to 9-year-old children; while 42% of 12- to 13-year-old children reported they do not eat breakfast every day. Nicklas, Reger, Myers, and O'Neil (2000) reported a lower rate of breakfast skipping among 711 fifteen year-old students in New Orleans, Louisiana who were 84% White and 16% non-White (African American, Hispanic or Asian). Nineteen percent skipped breakfast and females (23%) skipped breakfast more than males (14%). White females (20%) skipped breakfast less than non-White females (36%). Another sample of 4,175 adolescents with the majority (86.2%) aged 14 to 17 years indicated that approximately 42% had skipped breakfast within the past five days. This sample of adolescents was 29.0% White females, 25.2% White males, 25.1% African American females, and 20.8% African American males from South Carolina. White (44.2%) and African American females (46.9) skipped breakfast more than White (34.8%) and African American males (40.4%) over 5 school days (Zullig, Ubbes, Pyle, & Valois, 2006). Breakfast skipping has been attributed to the following reasons given by 4th, 5th, and 6th grade children: lack of time, not being hungry in the morning, or dieting to lose weight (Reddan, Wahlstrom, & Reicks, 2002). An international study of 1,202 Italian children reported that they skipped breakfast due to lack of time (62%) and lack of hunger upon waking (38%) (Vanelli et al., 2005).

Perez, Hoelscher, Brown and Kelder (2007) surveyed a sample of Texas children in the School Physical Activity and Nutrition Survey that included 15,173 4th, 8th, and 11th grade children. This sample was ethnically diverse with African American (10.9%) and Hispanic (38.3%) students. In this sample, 81.8% of 4th grade students, 81.1% of 8th grade students and 80.5% of 11th grade students ate breakfast. There were no significant differences in breakfast consumption across grade levels. These results are contrary to other studies. These differences may be due to the difference in questionnaires used by grade level. The 4th grade survey assessed breakfast intake on the previous day while the 8th grade and 11th grade surveys assessed usual breakfast consumption. Cereal intake decreased among children in higher grades compared with 4th grade children.

There is a trend among children as they grow into adolescence to decrease their breakfast intake. This may be detrimental to their health since there is evidence that breakfast consumption may favorably impact BMI. The relationship of breakfast and cereal intake on BMI was explored by the National Heart, Lung, and Blood Institute Growth and Health Study (Affenito et al., 2005; Barton et al., 2005). This longitudinal cohort study included 2,379 African American and White girls aged 9 years at baseline and they were followed for ten years. The study had three objectives: (a) describe breakfast and cereal consumption frequency, separately and combined, among both groups of girls from childhood through adolescence; (b) examine the impact on nutrient intakes of calcium, fiber, total fat, and cholesterol for cereal eaters; and (c) examine the relationships between breakfast, cereal intake, and BMI among these girls. Three-day food records including two weekdays and one weekend day were collected annually. Breakfast was considered eating between 5:00am and 10:00am on weekdays and eating between 5:00am and 11:00am on weekends. The number of days of breakfast consumption and cereal consumption was determined for each participant at each age. Breakfast consumption decreased significantly as participants aged. At 9 years of age, 77% of White girls and 57% of African American girls consumed breakfast on all three days compared with approximately 32% and 22%, respectively, by 19 years of age

(Affenito et al., 2005). White girls reported more frequent breakfast consumption than African American girls on all three days with the greatest racial difference occurring at 12 years of age and declining as the girls aged (Affenito et al., 2005). Cereal consumption also decreased with age. Nutrient intakes were calculated for cereal breakfast versus non-cereal breakfast and cereal days versus non-cereal days. Cereal breakfasts and cereal days had more fiber, calcium, iron, folic acid, vitamin C, and zinc (all $P<.0001$), and less fat and cholesterol (all $P<.0001$). The relationship between breakfast and cereal consumption and BMI was explored unadjusted then adjusted; the adjusted data controlled for the following confounding variables: age, data collection site, and mean daily energy intake. The unadjusted values indicated that girls who ate breakfast on three days had lower BMI than girls who skipped breakfast on all or most days. Another set of models with the same predictors represented BMI as continuous with BMI-for-age z-scores and as binary with "at risk of overweight" or "not at risk of overweight." Factors that may have influenced BMI were included in the statistical analysis such as number of parents in the household, parental education, race, physical activity, and total daily energy intake averaged for the three days of food records. The adjusted data indicated that the number of days of eating breakfast was not predictive of BMI z-score or risk of overweight. This longitudinal analysis of unadjusted data indicated that breakfast consumption was predictive of lower BMI in these participants; however, the adjusted data did not indicate the same relationship. This may be due to the fact that breakfasts not involving cereal consist primarily of foods that are not predictive of reduced BMI (Barton et al., 2005).

Another longitudinal study focused on breakfast skipping and BMI among American adolescents (Berkey, Rockett, Gillman, Field, & Colditz, 2003). A cohort of over 14,000 boys and girls aged 9 to 14 years from all fifty states participated in the Growing Up Today Study that analyzed BMI over three one-year periods among those who reported breakfast frequency. These participants were the offspring of Nurses' Health Study II participants. The participants were mostly White children (94.7%) with 0.9% African American, 1.5% Hispanic, 1.5% Asian, and 1.4% other (including Native American). There were contrasting results for children who were normal weight versus overweight. Overweight participants who never ate breakfast lost body fat compared to overweight subjects who ate breakfast nearly every day; however, normal weight children who never ate breakfast gained weight relative to peers who ate breakfast nearly every day.

Haines, Neumark-Sztainer, Wall, and Story (2007) evaluated over 2,500 adolescents in Minnesota who were surveyed at the beginning of their study and again five years later. Participants completed in-class dietary surveys and anthropometric measures during the 1998-1999 school year, and follow-up was done by mailed surveys. Approximately two-thirds (68%) of the participants were in high school with mean age of 15.8 years at baseline and a mean age of 20.4 years at follow-up. Almost one-third (32%) of the participants were in middle school with mean age of 12.8 years at baseline and a mean age of 17.2 years at follow-up. At baseline, eating breakfast more frequently was protective against being overweight at the follow-up five years later. Another study followed 9,919 adolescents for five years as they transitioned into adulthood, and examined the role of skipping breakfast on weight gain. This sample was nationally representative and participants had a mean age of 15.9 years at the first assessment and a mean age of 21.3 years at the follow-up. Participants were the following ethnicities: 66.1% White, 15.0% African American, 11.9% Hispanic, 4.1% Asian, 2.1% Native American, and 0.9% other. Breakfast consumption decreased over 5 years in this sample and fewer days of breakfast at follow-up predicted increased BMI z-scores at follow-up. At baseline, breakfast was eaten on 4.34 (±.06) days during the previous week in the total sample. African American (3.82 ± .09) and Native American (3.79 ± .24) adolescents ate breakfast on significantly fewer days during the past week than White adolescents (4.49 ± .07). At the 5-year follow-up, young adults ate breakfast an average of 3.09 (±.05) days for the total sample. African Americans (2.75 ± .09) and Asian Americans (2.83 ± .17) consumed breakfast on significantly fewer days than Whites (3.18 ± .17). This decrease in breakfast consumption predicted BMI z-scores; fewer days of breakfast consumption at baseline and a greater decrease in breakfast consumption between baseline and follow-up predicted increased BMI z-scores (Niemeier, Raynor, Lloyd-Richardson, Rogers, & Wing, 2006).

A cross-sectional study by Fiore et al. (2006) examined NHANES III (1988-1994) data from 1,890 adolescents aged 12-16 years. There was no association between breakfast and BMI in children with normal-weight parents or two obese parents. However, adolescents with at least one obese parent who ate breakfast every day had increased odds of having a healthy BMI compared with those who rarely or never ate breakfast.

Some studies investigated the relationship between breakfast and body weight instead of BMI. Among a sample of 8th grade children (n=1,543), overweight students were more likely to skip breakfast and eat two instead of more meals a day versus children who were not overweight. Dinner provided the most energy (807± 11 kcal mean± standard error), followed by lunch (666± 11 kcal), snacks (607± 11 kcal) and finally breakfast provided the least energy (394± 12 kcal) (Dwyer et al., 2001).

Another study by Roseman, Yeung, and Nickelsen (2007) surveyed 4,049 students in Central Kentucky. Ninety-eight percent of the sample was 11 to 14 years old; participants self-described their race: 61% White and 25% African American. The participant's self-reported height and weight were: 5% underweight, 64% healthy weight, 16% at risk for overweight and 15% overweight. This study used the CDC's previous classification criteria: children with a BMI-for-age below the 5th-percentile were underweight; children greater than or equal to the 85th-percentile but less than the 95th-percentile were classified as at risk of being overweight; and children at or above the 95th-percentile were classified as overweight. Breakfast intake was assessed by asking students how many days they ate breakfast during the past seven days with eight options ranging from "none" to "all 7 days." Breakfast intake was categorized as did not consume, 1 to 3 days in the past week, 4 to 6 days in the past week and every day. Forty-five percent of the participants ate breakfast every day of the week while 22% ate breakfast 1 to 3 days, 21% ate breakfast 4 to 6 days and 13% did not eat breakfast during the past week. Weight status was significantly associated with consumption of breakfast (x^2=53.94, p=0.01). Students who were a healthy weight consumed breakfast more frequently than students who were at risk of being overweight or were overweight. Breakfast skipping is a behavior that needs to be considered when addressing healthful weight management among children and adolescents.

A five-year study of 2,216 adolescents in public schools in Minnesota analyzed breakfast intake and weight change. There were two data collection points with a mean age of 14.9 ± 1.6 years at time 1 and a mean age of 19.4 ± 1.7 years at time 2. The ethnicity of the students was as follows: 63.1% White, 17.7% Asian, 9.9% African American, 3.8% Hispanic, 2.7% Native American, and 2.8% other or mixed. The cross-sectional analyses at times 1 and 2 found inverse associations between breakfast frequency and BMI that remained largely independent of confounding variables. The prospective analyses found that the frequency of breakfast was inversely associated with BMI in a dose-response manner. The adjustment of confounding and dietary factors did not appear to explain the association; however, the adjustment of weight-related variables such as weight concerns, behaviors, and social pressures appeared to partially explain the association. Dieting and weight-control behaviors were inversely associated with the frequency of breakfast suggesting that adolescents may choose to skip breakfast in an effort to control their weight (Timlin, Pereira, Story, & Neumark-Sztainer, 2008).

A sample of 3,275 children aged 5 to 14 years in New Zealand was studied to provide more explanation about the possible role of breakfast on body weight and key health-promoting child nutrition behaviors. New Zealand children, unlike children in the United States, do not have access to a universal school breakfast program that may impact intake. Therefore, breakfast consumption was assessed with the question, "Over the past week, did you eat or drink something before you left home for school in the morning?" The responses included "yes, usually"; "yes, sometimes"; or "no." Since there was a small number of "no" responses, the groups were changed into "usually" (regular breakfast consumption) or "sometimes/none" (skip breakfast). Breakfast intake was most common among the following groups: boys (87.2%), children aged 5 to 6 years (92.8%), children aged 7 to 10 years (86.8%), and children from more affluent neighborhoods (92.4%). Age made a difference in breakfast consumption with socioeconomic deprivation. Older children with the most socioeconomic deprivation were the least likely to consume breakfast. Breakfast skipping was associated with increased BMI (p=0.002). Breakfast skippers were significantly less likely to meet recommendations for fruit and vegetable intake (p=0.005) and more likely to be frequent eaters of unhealthy snack foods. There was no apparent association between breakfast consumption and physical activity (Utter, Scragg, Mhurchu, & Schaaf, 2007).

Another international study analyzed the breakfast habits of 1,202 Italian children aged 6-14 years participating in a Summer Sport School. Seventy-eight of the children reported that they usually ate breakfast and 22% reported skipping breakfast. A high prevalence of overweight and obesity was found among the breakfast-skippers; 27.5 % were overweight and 9.6% were obese versus 9.1% and 4.5% in those eating breakfast, respectively (Vanelli et al., 2005).

There are several studies that support the association between breakfast consumption and BMI or body weight. However, not all studies support this finding. Dialektakou & Vranas (2008) examined the following: whether an association exists depending on the definition of breakfast skipping (24 definitions were used), examined BMI and overweight/obesity and controlled for potential confounding variables. The sample included 811 Greek students (382 males and 429 females) with a mean age of 16.62 years. There was a significant association between breakfast skipping and BMI, and there was a significant association between breakfast skipping and overweight or obesity. However, there were fewer breakfast skipping variables associated with BMI than overweight/obesity. There was a significant association in 29 out of the 48 adjusted models but in 35 out of the 48 unadjusted models. There were fewer associations when controlling for confounding variables. There were fewer associations found for variables corresponding to some definitions of breakfast skipping than for variables of other breakfast definitions. Overall, these results indicated that whether an association is found or not depends on how breakfast is defined, and researchers are more likely to find an association if they use the dichotomous variable of overweight or obese versus the continuous variable of BMI.

Overall, there appears to be a relationship between breakfast consumption and BMI that is protective. Those who eat breakfast have a favorable BMI or body weight and tend to have other healthy dietary behaviors such as an increased fruit and vegetable intake and decreased unhealthy snack food intake (Affenito et al., 2005; Barton et al., 2005; Berkey, Rockett, Gillman, Field, & Colditz, 2003; Dwyer et al., 2001; Haines, Neumark-Sztainer, Wall, & Story, 2007; Niemeier, Raynor, Lloyd-Richardson, Rogers, & Wing, 2006; Roseman, Yeung, & Nickelsen, 2007; Utter, Scragg, Mhurchu, & Schaaf, 2007).

RTEC Consumption as It Relates to BMI

The development of RTEC began in the early 1900s. In 1906, W.K. Kellogg began the production of Toasted Corn Flakes at the Battle Creek Toasted Corn Flake Company in Michigan. In 1928, Kellogg's Rice Krispies ® appeared on the market as the "talking cereal" because of the distinctive popping sound when milk was added. In 1938, Kellogg's Pep® became the first cereal fortified with vitamins through the "spray" method, marking the beginning of the cereal industry's food fortification processes. In 1956, Kellogg's Special K® was the first cereal fortified with seven vitamins and iron hence the "special" distinction (Kellogg Company, 2007). Today, there are over 300 brand name RTECs on the market plus many private label brands (List of breakfast cereals).

Currently, most RTECs are fortified with vitamins and minerals. The majority of states have laws requiring refined wheat products to be enriched with nutrients removed during milling. These nutrients include thiamin, riboflavin, niacin, iron, and folic acid. Federal standards exist for enrichment of not only wheat, but also corn meal and rice (American Association of Family & Consumer Sciences, 2006). These grains are the basic ingredients of most RTEC produced in the U.S. In addition to being enriched, most RTEC are also fortified. Fortification is the process of adding nutrients to a product that were not originally present to reduce risk of nutrient deficiencies in the population (Brown, 2008). RTEC are commonly fortified with calcium, zinc, vitamins C and A, vitamins B_6 and B_{12}, and vitamin D_3.

Beyond the potential protective role of breakfast consumption, the question of what the breakfast consists of comes into consideration. Barton et al. (2005) examined RTEC and cooked cereal consumption grouped together and BMI during the National Heart, Lung, and Blood Institute Growth and Health Study. The unadjusted values indicated that girls who ate cereal on three out of three possible days had lower BMI compared to girls who did not eat cereal. Also, those consuming breakfast on three days had decreased BMI compared to girls who skipped breakfast on all or most days. Another set of models with the same predictors represented BMI as continuous with BMI-for-age z-scores and as binary with "at risk of overweight" or "not at risk of overweight." Factors that may influence BMI mentioned previously were adjusted. The adjusted data indicated that the number of days of eating cereal was predictive of BMI z-scores and risk of overweight. Cereal consumption was predictive of lower BMI in these participants. BMI increased as these girls grew into adolescence as would be expected; however, cereal eaters were leaner than girls who did not eat cereal (Barton et al., 2005).

The results of Barton et al. (2005) are supported by Albertson, Anderson, Crockett and Goebel (2003) who examined the relationship of RTEC intake and BMI among a sample of 4 to 12-year-old children. A sample of 603 children was broken into tertiles based on cereal consumption over 2 weeks. The categories for cereal consumption were three to fewer, four to seven, or eight or more servings over fourteen days. Over 90% of these children ate RTEC at least once during the two-week period. There was a significant inverse relationship between BMI and frequency of cereal consumption ($p< .01$) within each age group (4-6 years, 7-9 years, 10-12 years) and for the total sample. Children aged 4 to 12 years who ate eight or more servings of RTEC over the 2 week period had significantly lower BMI compared to children who ate two or fewer servings ($p < .0001$). There was a significant inverse relationship between the population at risk for being overweight and frequency of cereal consumption ($p < .01$). According to the CDC (Kuczmarski, Ogden, & Guo, 2002), 33.7% or approximately one in three children aged 4 to 12 years is at risk for overweight. Albertson et al. (2003) reported that children within the same age range who consumed RTEC eight or more times in two weeks decreased their risk of being overweight by 21.3% or approximately one in five. However, when children ate RTEC zero to three times in two weeks their risk for being overweight increased to 47.4% or almost one in two.

RTEC Consumption as It Relates to Nutrient Intakes

The nutrient density of RTEC, many of which are fortified with vitamins and minerals, can be an important determinant of overall diet quality. Nutrient intakes of children were examined by Barton et al. (2005) for RTEC breakfast versus non-RTEC breakfast and RTEC days versus non-RTEC days. The nutrient intakes of those with RTEC breakfasts and RTEC days had more fiber, calcium, iron, folic acid, vitamin C, and zinc (all $p<.0001$), and less fat and cholesterol (all $p<.0001$) than non-RTEC breakfasts and non-RTEC days. These findings were supported by Albertson et al. (2003) among 603 children aged 4 to 12 years. Nutrient intakes of vitamin A, vitamin B-6, thiamin, riboflavin, niacin, folate, calcium, iron, and zinc increased from the lowest tertile of cereal intake to the upper tertile of cereal intake. Nicklas, O'Neil and Myers (2004) reported greater mean intakes of thiamin, riboflavin, niacin, folate, iron, and vitamins A, B-6, and B-12 among 10-year-old children and young adults aged 19 to 28 years who ate RTEC than those who did not eat RTEC. Young adults who ate RTEC had greater or increased mean intakes of magnesium and calcium than young adults who did not eat RTEC. The positive relationship between RTEC intake and nutrient intakes can be partially explained by nutrient fortification, increased dietary fiber, and low fat content of the cereals (Albertson et al., 2003; Nicklas et al., 2004).

The intake of RTEC among 392 adolescents in Greece was examined as it relates to nutrient intakes by Kafatos et al. (2005). RTEC consumption was determined using a food frequency questionnaire and nutrient intakes were calculated using a 24-hour dietary recall. Forty-two percent of boys and 43% of girls reported RTEC consumption as least once per week. RTEC consumers had significantly greater or increased intakes of fiber, magnesium, calcium, iron, folate and vitamins A, B2, and B6.

Albertson et al. (2008) provided more support to the finding of increased nutrient intakes of fiber, iron, folic acid, and zinc when RTEC was consumed at breakfast. RTEC consumption also appeared to increase milk consumption thereby increasing calcium consumption and displacing other breakfast foods such as fats/sweets, quick breads, and soda. The choice of RTEC at breakfast was also associated with increased fiber and carbohydrate intakes and decreased fat consumption throughout the day. An interesting finding was RTEC consumption was associated with greater physical activity therefore helping promote a healthy lifestyle.

Nutrient content of breakfast foods eaten is an important determinant of overall diet quality. Children who consume RTEC have increased intakes of calcium, iron, folate, zinc, vitamin A, vitamin B-6, thiamin, riboflavin, niacin, fiber, vitamin C, and decreased fat and cholesterol intakes (Albertson, Anderson, Crockett, & Goebel, 2003; Barton et al., 2005). In a sample of 567 9th-grade students in New Orleans, 5% (n=24) ate a fast-food breakfast, 30% (n=173) ate RTEC, and 65% (n=370) chose other breakfasts (Nicklas, McQuarrie, Fastnaught, & O'Neil, 2002). Mean energy intake of fast-food breakfast eaters (mean=669 kcal) was significantly greater ($p<0.0001$) than RTEC eaters (mean=376 kcal) or other breakfast food eaters (mean=464 kcal). After energy intakes were adjusted, total fat intake per 1,000 kcal was almost four times greater and saturated fat was almost double fast-food breakfast eaters versus RTEC eaters. RTEC breakfast was a more nutritious meal overall compared to other or fast-food breakfasts. RTEC breakfast had the least total fat and saturated fat and greater amount of carbohydrate, fiber, and protein. Overall, RTEC breakfast was most nutritious with regards to vitamins and minerals when compared to other or fast-food breakfasts (Nicklas, McQuarrie, Fastnaught, & O'Neil, 2002).

American children and adolescents are not meeting their daily calcium requirements, and this has become a public health concern (American Academy of Pediatrics, 1999; Song et al., 2006). One of the most commonly eaten foods with milk is RTEC. Therefore, the consumption of RTEC may enhance milk and calcium intake among Americans. Song et al. (2006) examined the association between RTEC consumption and milk and calcium intake using the National Health and Nutrition Examination Survey, 1999-2000, for subjects aged 4 years and older. The results indicated that RTEC was predominantly consumed at breakfast and the average calcium intake at breakfast was seven times greater when RTEC was consumed with milk than when RTEC was consumed without milk. Breakfast consumption and milk consumption with or without RTEC were strong predictors of total calcium intake (Song et al., 2006).

Recommendations

According to the International Food Information Council (IFIC) Food and Health Survey (2008), 92% of Americans perceive breakfast to be either extremely or somewhat important; however, only 46% of Americans eat breakfast every day. Some of the reasons found in the survey for not eating breakfast were not being hungry right after waking up, not enough time to eat breakfast, not having convenient breakfast options available, forgetting to eat breakfast, and not sure what to eat. There are strategies to reduce the likelihood of skipping breakfast; for example, time may be an obstacle so relying on quick, nutritious options such as RTEC with low-fat milk may be a good solution (IFIC, 2008). Fortified cereal bars may be another convenient option for busy lifestyles.

The IOM Report on Nutrition Standards and Meal Requirements for National School Lunch and Breakfast Programs (2008) indicated that nutrient standards for several nutrients are under consideration for revision. The report indicated that for children aged 9-13 years the foods for which intakes are inadequate are as follows: fruit, total vegetables, dark green and orange vegetables and legumes, whole grains, total meat and beans, and milk. The nutrients for which intakes are inadequate for males and females aged 9-13 years are calcium, magnesium, potassium, phosphorus, vitamins A, C, E, zinc, and fiber. The nutrients for which intakes are excessive are sodium, cholesterol, and saturated fat. These findings will help guide the development of Nutrition Standards and Meal Requirements and school breakfast meals will reflect these requirements in the future.

Parents play an important part in establishing life-long behaviors for their children. Parent can be role-models of breakfast eating and encourage their families to routinely eat breakfast while stressing the benefits such as improved academic performance (IFIC, 2008). Videon and Manning (2003) examined eating patterns among 18,177 adolescents and found that the most significant parental influence was the family meal. Family meals lowered the odds of poor consumption of fruits, vegetables, and dairy foods and also lowered the odds of not eating breakfast. Parents can influence their children's dietary behaviors; specifically, adult food modeling may impact the development of healthful eating habits by parents showing their children the importance of healthy eating (American Dietetic Association, 2008).

The characteristics of an ideal breakfast have been outlined by Giovannini et al. (2008). Their recommendations included: all the family eating breakfast together; parents as the role-models of daily breakfast consumption, palatable and healthy foods consumed for breakfast; and breakfast providing 20-35% of the daily calorie intake. The researchers recommended including three food groups in the breakfast meal. For example, a well-balanced breakfast may include low-fat milk and milk products, preferably unrefined, whole-grain cereal, and fresh fruit or fruit in natural juices with no added sugar.

School-based interventions provide advantages to American children. Over 95% of American children eat 1-2 meals daily at their school. The school cafeteria and classroom provide a setting to help promote healthful eating habits such as routine breakfast consumption. Every American child should have access to a nutrient-rich meal, regardless of income and be educated on the importance of eating nutrient-rich foods at every eating occasion (Kennedy & Davis, 1998).

Summary

Overweight children are more prone to becoming overweight adults and developing type 2 diabetes, especially Hispanic children. Several school-based health promotion programs have introduced healthful behaviors such as increased fruit and vegetable intake with the goal of overweight prevention among children. Overweight prevention for children and adolescents may include a variety of dietary behaviors that have yet to be identified. Dietary patterns such as eating breakfast may contribute positively to a child's BMI and overall nutrient intake. Breakfast has established its role as one of, if not, the most important meal of the day. Breakfast consumption makes a significant nutritional contribution to total daily intake of children and adolescents (Nicklas, O'Neil, & Berenson, 1998; Nicklas, Reger, Myers, & O'Neil, 2000). Breakfast skippers are also less likely to meet their fruit and vegetable recommendations and are more likely to consume unhealthy snack foods (Utter, Scragg, Mhurchu, & Schaaf, 2007). However, breakfast consumption tends to decline as children grow into adolescence (Barton et al., 2005; Miller, Forgac, Cline, & McBean, 1998; Siega-Riz, Popkin, & Carson, 1998). There is an ethnic difference in breakfast consumption seen with African American children eating breakfast less frequently than White children (Barton et al., 2005; Niemeier, Raynor, Lloyd-Richardson, Rogers, & Wing, 2006). The foods chosen to be eaten for breakfast have an impact on nutrient intakes as well. RTEC for breakfast increases nutrient intakes of several vitamins and minerals and its consumption has been linked to a lower BMI for children and adolescents (Albertson, Anderson, Crockett, & Goebel, 2003; Barton et al., 2005; Nicklas, McQuarrie, Fastnaught, & O'Neil, 2002).

There is a gap in the knowledge of breakfast eating patterns among Hispanic children. More research may provide insight into the relationship with BMI and nutrient intakes and may help impact future recommendations for health-promoting dietary patterns among Hispanic children.

CHAPTER III

METHODS

Subjects

Data for this study was collected as part of a larger study, Bienestar: A School-Based Type 2 Diabetes Prevention Program, from students enrolled in elementary schools who participated in this program within the San Antonio Independent School District. The purpose of the Bienestar Program was to use a culturally appropriate school-based diabetes mellitus prevention program to reduce the risk of development of type 2 diabetes mellitus in low-income Hispanic children. The study was carried out in 27 schools within the San Antonio Independent School District. Schools were randomized into either control schools (14) or intervention schools (13). The intervention consisted of four components (classroom curriculum, school cafeteria staff education, parent-guardian education, and after-school educational activities) designed to reinforce the following daily behaviors: decrease total dietary saturated fat intake, increase dietary fiber intake, and increase physical activity. Students were recruited at the beginning of the 2001-2002 4^{th} grade school year and tracked through their 6^{th} grade year.

This study analyzed the data that was previously collected from the control schools for the purpose of answering the three research questions. There were male and female students at each school. All fourth-grade children, regardless of gender, race, and ethnicity, were eligible for participation. The control schools were Arnold, Baskin, Carroll, Douglass, Foster, Hillcrest, Huppertz, Lamar, Miller, Ogden, Stewart, W.W. White, Wilson, and Hawthorne elementary schools. At baseline within the control group, 95.1% (SD=4.01) were economically disadvantaged students (based on free and reduced school lunch program eligibility).

The exclusion criteria for students included enrollment in elementary schools with previous exposure to the Bienestar Program, age > 12 years at baseline, and previous diagnosis as type 1 or type 2 diabetes mellitus.

Table 2

Characteristics of the Sample

	4^{th} Grade n=624	5^{th} Grade n=577	6^{th} Grade n=488
Gender, %			
Male	49.5	49.9	50.8
Female	50.5	50.1	49.2
Age, mean (SD), years	9.12 (0.46)	10.66 (0.58)	11.60 (0.57)
Ethnicity, %			
Hispanic	78.2	78.5	79.3
African American	11.9	12.7	12.5
White	6.1	4.7	4.3
Other	3.8	4.2	3.9
School District, %			
SAISD	100	95	92.4

Procedures

Students were recruited by a letter from Bienestar Research Center sent to the parent/guardian with a consent/assent form in both English and Spanish. The parent/guardian signed the consent and the child signed the assent at the beginning of the study at the 4th grade school year. Children who returned written informed consent forms signed by their parent or guardian and who assented to the study participated in data collection steps at both intervention and control schools as described below. Children at the control schools only participated in data collection steps and not program intervention. Each participant went through the following data collection steps at three points in time after consent/assent was obtained at beginning of the 4th grade school year. The three points in time were as follows: (a) beginning of the 4th grade school year, (b) end of the 5th grade school year, and (c) end of the 6th grade school year. Each participant went through the following data collection steps:

1. Bienestar staff collected dietary data from each student during a one-on-one interview that was manually recorded on three 24-hour diet recalls; interviews were performed on-site at each elementary school.
2. Each participant completed a questionnaire on-site at each elementary school and reported their age, gender, and ethnicity.
3. Each participant was measured for height and weight on scales and this information was then used to calculate his or her BMI.
4. Each participant completed the Harvard Step Test to assess his or her level of physical fitness.

Dietary recalls have been found to be reliable and valid in children in this age group for this study (Carter, Sharbaugh, & Stapeli, 1981; Frank, Berenson, Schilling, & Moore, 1977). The dietary data was recorded over 3 consecutive days according to the following schedule: Monday interview recorded what the student ate on Sunday, Tuesday interview recorded what the student ate on Monday, and Wednesday interview recorded what the student ate on Tuesday. The dietary intake data was collected on 3 different visits to the school so the child only had to recall one day's food intake at a time. The 24-hour diet recalls used several techniques to maintain accuracy. The dietary interviewing technique included a script for dialogue, prompting methods, and recording methods. The dietary measuring technique used food models and measuring utensils to increase accuracy of the portion sizes.

Anthropometric data was collected using the following techniques: each participant's height was measured with his or her shoes and socks removed using a wall mounted stadiometer (Seca Bodymeter 206; Seca Corp, Hanover, Maryland) and body weight was determined using a combination weight scale/bioelectric impedance instrument (Tanita Corporation of America, Inc., Arlington Heights, Illinois).

Physical fitness index instead of physical activity was assessed because activity recall questionnaires in children younger than ten years of age are less reliable and valid than those in older children (Sallis, Buono, Roby, Micale, & Nelson, 1993; Saris, 1986). Physical fitness was measured using the modified Harvard Step Test (Bruce, 1974). The test used a heart rate monitor transmitter (Polar Vantage XL; Polar Electric Company, Port Washington, New York) placed on the lower part of the child's chest and another monitor was connected to the child's wrist. A baseline heart rate was recorded then the child was asked to begin stepping onto and off a stool (30 centimeters high, 42 centimeters wide, and 38 centimeters deep) with both feet, for five minutes. The child was paced at 30 cycles per minute. The child's heart rate was recorded at 0, 1, and 2 minutes after the child either finished the five minute test or stopped the test early. A physical fitness score was calculated from the total time of exercise (in seconds) multiplied by 100 and divided by the sum of the three heart rate values taken 0, 1, and 2 minutes after the exercise was completed.

Dietary intake data was analyzed using Nutrition Data System for Research (NDS-R) version 2006 (Nutrition Coordinating Center, University of Minnesota, Minneapolis).

Statistical Analyses

The predictor variables are breakfast and RTEC consumption. The outcome variables are BMI and nutrient intakes of calcium, magnesium, iron, vitamin A, vitamin C, and fiber. The frequency of breakfast and RTEC consumption will be categorical variables based on reporting from the student. The frequency of breakfast consumption will be determined as 0=no breakfast, 1= 1 day of eating breakfast, 2= 2 days of eating breakfast, and 3= 3 days of eating breakfast. Based on participants who consumed breakfast, RTEC consumption will be defined as 0=no RTEC for breakfast, 1= 1 day of eating RTEC for breakfast, 2= 2 days of eating RTEC for breakfast, and 3= 3 days of eating RTEC for breakfast. BMI will be a continuous variable calculated for each participant using the following formula: BMI= [weight in kilograms/(height in meters)^2]. Nutrient intakes will be continuous variables estimated from the dietary analysis for each participant and will be calculated as an average of the 3 days of dietary intake. The intakes of the following nutrients were analyzed: calcium, magnesium, iron, vitamin A, vitamin C, and fiber.

The nutrients (calcium, magnesium, iron, vitamin A, vitamin C, and fiber) that are included for analysis in this study were chosen based on the following rationales. Calcium, magnesium, iron, vitamin A, vitamin C, and fiber were found to have significant relationships with RTEC in previous studies that involved children and adolescents (Albertson et al., 2003; Barton et al., 2005; Kafatos et al., 2005; Nicklas, O'Neil, & Myers, 2004; Song et al., 2006). RTEC may be a good source of magnesium, iron, and fiber (USDA, 2005). RTEC is usually accompanied by milk and milk is the number one source of calcium, magnesium, and vitamin A in diets of children aged 2-18 years (Song et al., 2006; United States Department of Health and Human Services and USDA, 2005). Calcium, magnesium, and fiber are three of the five U.S. Dietary Guidelines' nutrients of concern for children and adolescents based on actual prevalence of inadequacy (USDA, 2005). Calcium, iron, vitamin A, and vitamin C are required nutrient standards for school breakfast meals based on USDA guidelines (School Nutrition Association, 2008).

The control variables are age, gender, energy intake, ethnicity, and physical fitness. The control variables will be coded as follows: age will be a continuous variable; gender will be dichotomously coded as 1=male and 2=female; ethnicity will be coded as 1=Hispanic, 2= White, 3= African American, 4=other ethnic group; energy intake and physical fitness will be measured using continuous variables. The nominal variable, ethnicity, had four categories therefore three vectors were created to represent this variable in the analysis.

The research questions will be answered using Ordinary Least Squares regression. Data will be screened for typographical and other errors, assumptions, collinearity, and influential data. The significance level of the entire study will be set at alpha=.05/8=.00625. Statistical analyses will be performed using SPSS for Windows Statistical Software (version 16).

CHAPTER IV

RESULTS

Data Screening and Diagnostics

Initially, the researcher performed regression diagnostics that was aimed at detecting errors in the data. The data was screened for typographical, recording, input, measurement, and transcription errors. This part of the screening captured impossible values using frequencies and histograms for each variable. Each variable was screened to determine any values outside of the range of "normal." For example, each micronutrient and total caloric intake were evaluated for any values below the 1^{st} percentile and above the 99^{th} percentile for usual intakes of children aged 9 to 13 years for both sexes based on Continuing Survey of Food Intakes of Individuals (CSFII), 1994-1996. The frequency table for each micronutrient was used to determine those values for students who were above and below those values. Then those students' dietary records were reviewed for potential errors. BMI was screened for values above the 100^{th} and below the zero percentile for BMI-for-age.

The next step of screening was examining each bivariate scatterplot of each predictor and outcome and then between all predictors. For example, the 4^{th} grade students were examined by plotting the frequency of breakfast, the predictor, and BMI, the outcome. This was done for each grade level and each predictor, i.e., frequency of breakfast and ready-to-eat cereal (RTEC), and outcome (BMI, calcium, magnesium, iron, vitamin A, vitamin C, and fiber). Each scatterplot was used to screen for additional errors in the data not seen in the frequencies such as unusual values and curvilinear relationships or any potential strong correlations between predictors. Any outliers, or data points that were distant from the rest of the data were examined to determine if they were true errors.

The control sample at baseline consisted of 721 students. Ninety-seven 4^{th} grade students were excluded based on the following: 87 students had missing dietary intake recalls, 3 students had less than 3 days of dietary recalls, 6 students had dietary recalls marked unreliable by interviewer, who was research center staff, and 1 student was missing ethnicity, physical fitness score, and BMI. Forty-seven 5^{th} grade students were excluded based on the following: 40 students had missing dietary intake recalls, 4 students had less than 3 days of dietary recalls and 3 students had dietary recalls marked unreliable by interviewer. Eight-nine 6^{th} grade students were excluded based on the following: 80 students had missing dietary intake recalls, 2 students had less than 3 days of dietary recalls and 7 students had dietary recalls marked unreliable by interviewer.

The initial residuals analysis was performed between each predictor and outcome variable. Scatterplots were obtained to screen for curvilinear relationships, violations of homoscedasticity, and additional errors in the data or outliers. The assumption of homoscedasticity is that the variability around the regression line is the same versus heteroscedasticity where the variability is different at different levels. Histograms of the standardized residuals were used to screen for additional errors in the data and detached values or outliers.

The assumption of independence related to time was tested. The dates of dietary data collection were used to predict the outcomes. For example, the dates of dietary data collection for the 4th grade students were plotted against BMI. These scatterplots of the residuals were obtained to screen for any systematic patterns. There was no violation of the assumption of time.

Collinearity diagnostics were performed on all variables. Collinearity is a problem that occurs when one or more of the independent variables are highly correlated with the other independent variables in the regression equation. These two variables will be represented as plotting on the same line on a graph if they are exactly correlated. Collinearity is so detrimental to regression statistics that it may cause the results to be useless if not very deceptive (Pedhazer, 1997). The variance inflation factor (VIF) provides an indicator of the amount of variance of "b," the regression coefficient, as a result of the correlation between the independent variables. The higher the correlation is between the independent variables then the greater the value of VIF. A common rule of thumb is a VIF value greater than 10 indicates a significant case of collinearity (Cohen, Cohen, West, & Aiken, 2003). The VIF values were obtained using SPSS and then examined for any values greater than 10 and there were no values greater than 10; therefore , there were no problems with collinearity.

The next residuals analysis involved multiple variables including all control variables and predictors. For example, for the 4th grade students the frequency of breakfast, the predictor, was analyzed along with the control variables, gender, age, ethnicity, energy intake, and fitness level. Histograms were obtained to screen for values above three standard deviations. These cases were located and checked to see if any new unusual values appeared in the analysis. There were no new unusual values.

The influence analysis used standardized DFFITS to determine any influential points. DFFITS represents "difference in fit, standardized" and is a diagnostic used to indicate how influential a point is in statistical regression. DFFITS provided information regarding how, in this study, a subject affects overall characteristics of the regression equation by comparing the regression equation with and without the subject in the data set. Each grade level had eight DFFITS histograms that indicated no values above 2 standard deviations. According to Cohen, Cohen, West, and Aiken (2003), for a large-sized data sets, DFFITS > $2\sqrt{(k+1)/n}$ should be considered potentially influential. The histogram of RTEC frequency and vitamin A intake was an interesting example of influential points. The residuals analysis histogram indicated several detached values well above 3 standard deviations. This was unique to this micronutrient due to the intake of specific foods rich in vitamin A such as liver that elevated the average intake of this micronutrient. However, after the standardized DFFIT was obtained, the graphic representation indicated that there were no values above 2 standard deviations and therefore no influential points to exclude. Because there were no histograms with DFFITs greater than 2 standard deviations, the researcher concluded that there were no influential points among all variables; therefore, all subjects were retained for the final analysis.

Test of Hypotheses

The results of the tests of hypotheses are shown in Tables 3-5. Among 4th grade students, the frequency of RTEC consumption was a significant predictor of BMI, and the intakes of calcium, magnesium, iron, and vitamin C ($p< .00625$), controlling for age, gender, ethnicity, energy intake, and physical fitness. Among 5th grade students, the frequency of RTEC consumption was a significant predictor of intakes of calcium, magnesium, iron, vitamin A, and vitamin C ($p< .00625$), controlling for age, gender, ethnicity, energy intake, and physical fitness. Among 6th grade students, the frequency of RTEC consumption was a significant predictor of calcium, magnesium, and iron ($p<.00625$), controlling for age, gender, ethnicity, energy intake, and physical fitness. The significance level was set at alpha=.05, however, there are eight hypotheses being tested; therefore alpha= .05/8=.00625.

The frequency of eating breakfast and RTEC consumption shifted from the 4th to the 6th grade. There was a gradual increase towards skipping breakfast from the 4th to the 6th grade and the number of students who ate breakfast on all three of the dietary recall days decreased (Table 6). For the students who did consume breakfast, those choosing foods other than RTEC increased from the 4th to the 6th grades and those consuming RTEC on all three of the dietary recall days decreased (Table 7). The frequency of RTEC consumption and subsequent micronutrient intakes are shown in Tables 8-10.

Table 3

Fourth Grade Students' Predictor and Outcome Variables

Outcome	Predictor	R^2 Change	F	df	p[a]	R^2-control variables[b]
BMI	Breakfast[c]	.001	.844	1,615	.359	.223
BMI	RTEC[d]	.014	10.888	1,601	<.0005*	.225
Calcium	RTEC	.027	31.032	1,601	<.0005*	.442
Magnesium	RTEC	.020	41.107	1,601	<.0005*	.684
Iron	RTEC	.119	238.672	1,601	<.0005*	.580
Vitamin A	RTEC	.002	1.512	1,601	.219	.173
Vitamin C	RTEC	.019	13.817	1,601	<.0005*	.176
Fiber	RTEC	.002	1.799	1,601	.180	.451

[a]Significance level .05/8= .00625
[b]Age, gender, ethnicity, energy intake, and physical fitness
[c] Breakfast- eating breakfast each morning of data collection
[d] RTEC- ready-to-eat cereal consumption
* Significant result

Table 4

Fifth Grade Students' Predictor and Outcome Variables

Outcome	Predictor	R^2 Change	F	df	p[a]	R^2-control variables[b]
BMI	Breakfast[c]	.003	2.293	1,568	.131	.217
BMI	RTEC[d]	.005	3.440	1,541	.064	.218
Calcium	RTEC	.054	52.847	1,541	<.0005*	.395
Magnesium	RTEC	.023	48.758	1,541	<.0005*	.725
Iron	RTEC	.104	192.013	1,541	<.0005*	.601
Vitamin A	RTEC	.032	22.525	1,541	<.0005*	.194
Vitamin C	RTEC	.013	8.768	1,541	.003*	.207
Fiber	RTEC	.000	.442	1,541	.506	.521

[a]Significance level .05/8= .00625
[b]Age, gender, ethnicity, energy intake, and physical fitness
[c] Breakfast- eating breakfast each morning of data collection
[d] RTEC- ready-to-eat cereal consumption
* Significant result

Table 5

Sixth Grade Students' Predictor and Outcome Variables

Outcome	Predictor	R^2 Change	F	df	p[a]	R^2-control variables[b]
BMI	Breakfast[c]	.001	.861	1,479	.354	.212
BMI	RTEC[d]	.010	5.926	1,444	.015	.216
Calcium	RTEC	.037	31.775	1,444	<.0005*	.443
Magnesium	RTEC	.009	12.942	1,444	<.0005*	.691
Iron	RTEC	.102	160.197	1,444	<.0005*	.616
Vitamin A	RTEC	.007	3.991	1,444	.046	.188
Vitamin C	RTEC	.001	.530	1,444	.467	.123
Fiber	RTEC	.001	1.056	1,444	.305	.486

[a]Significance level .05/8= .00625
[b]Age, gender, ethnicity, energy intake, and physical fitness
[c] Breakfast- eating breakfast each morning of data collection
[d] RTEC- ready-to-eat cereal consumption
* Significant result

Table 6

Sample Size and Percentage of Students Reporting Frequency of Breakfast Consumption and Mean Number of Breakfast Days by Grade Level (Based on 3 Days of Dietary Recalls)

Grade Level	Sample Size	Days of Breakfast Consumption (%) 0	1	2	3	Mean days of breakfast
4th	624	2.2	9.1	24.4	64.3	2.5*
5th	577	4.7	15.6	24.8	54.9	2.3*
6th	488	7.2	22.1	29.7	41.0	2.1*

*p< .0005

Table 7

Sample Size and Percentage of Students Reporting Frequency of RTEC for Breakfast Consumption and Mean Number of RTEC Days by Grade Level (Based on 3 Days of Dietary Recalls)

Grade Level	Sample Size	Days of Breakfast Consumption (%) 0	1	2	3	Mean days of breakfast
4th	610	32.3	29.8	26.4	11.5	1.2*
5th	550	36.7	32.4	21.6	9.3	1.0*
6th	453	44.2	33.6	18.3	4.0	0.8*

*p= .043
**p=.001
***p< .0005

Table 8

Mean Daily Micronutrient Intakes by Frequency of RTEC Consumption Among 4th Grade Students (Based on 3 Days of Dietary Recalls)

Micronutrient	Dietary Reference Intake*	Frequency of RTEC Consumption			
		0 n=197	1 n=182	2 n=161	3 n=70
Calcium (mg)	1,300	699.8	729.7	832.0	804.5
SD		271.1	288.3	353.0	313.7
Magnesium (mg)	240	172.9	180.0	189.5	196.0
SD		59.9	60.3	59.5	68.7
Iron (mg)	8	10.1	11.4	12.7	14.5
SD		3.9	3.8	3.8	4.5
Vitamin A (IU)	2,000	2847.2	3042.1	3105.3	3125.0
SD		2138.0	2579.7	2007.1	1512.1
Vitamin C (mg)	45	67.7	65.5	73.5	85.2
SD		41.5	36.3	39.0	40.6
Fiber (gm)	30	9.3	10.9	10.6	10.8
SD		4.8	5.3	4.3	4.8

* Institute of Medicine DRI based on 9-13 year old boys and girls

Table 9

Mean Daily Micronutrient Intakes by Frequency of RTEC Consumption Among 5th Grade Students (Based on 3 Days of Dietary Recalls)

Micronutrient	Dietary Reference Intake*	Frequency of RTEC Consumption			
		0 n=202	1 n=178	2 n=119	3 n=51
Calcium (mg)	1,300	688.0	771.2	858.4	919.1
SD		284.8	311.8	339.1	280.7
Magnesium (mg)	240	182.2	190.5	210.4	213.4
SD		66.5	61.3	66.6	64.7
Iron (mg)	8	11.1	12.9	14.7	15.9
SD		4.4	4.3	4.1	4.9
Vitamin A (IU)	2,000	2738.7	3042.1	3476.7	3963.0
SD		1775.7	1844.8	2183.3	2569.1
Vitamin C (mg)	45	70.4	72.8	81.7	88.2
SD		50.0	42.6	47.0	48.2
Fiber (gm)	30	11.3	11.1	12.0	11.3
SD		4.9	4.6	5.1	4.2

* Institute of Medicine DRI based on 9-13 year old boys and girls

Table 10

Mean Daily Micronutrient Intakes by Frequency of RTEC Consumption Among 6th Grade Students (Based on 3 Days of Dietary Recalls)

Micronutrient	Dietary Reference Intake*	Frequency of RTEC Consumption 0 n=200	1 n=152	2 n=83	3 n=18
Calcium (mg)	1,300	689.0	765.7	866.	826.1
SD		298.4	302.6	361.3	361.8
Magnesium (mg)	240	189.1	193.8	214.6	196.0
SD		69.3	69.6	87.0	76.4
Iron (mg)	8	12.0	13.8	16.6	16.9
SD		4.6	4.9	6.0	6.1
Vitamin A (IU)	2,000	2595.0	3185.4	3064.9	2992.0
SD		1646.0	2481.2	1478.0	1313.5
Vitamin C (mg)	45	73.0	62.0	79.0	85.2
SD		52.0	40.0	47.1	55.7
Fiber (gm)	30	11.5	11.4	12.6	10.2
SD		5.1	5.4	6.2	5.1

* Institute of Medicine DRI based on 9-13 year old boys and girls

The fiber content of the top ten most commonly consumed RTECs in the 5th and 6th grades are listed in Tables 11-12. If a participant indicated that they did not remember the type of RTEC that was consumed at breakfast then the RTEC was entered as "unknown type." According to the NDS-R nutrition database, the "unknown type" is computed as the most commonly consumed RTEC that is Cheerios® based on Nielsen data. Table 13 describes the daily values of calcium, magnesium, iron, vitamin A, and vitamin C for the most commonly consumed RTEC in the 5th and 6th grades combined.

Table 14 indicates where the breakfast meal was consumed at each grade level. Table 15 ranks the top ten most frequently consumed foods in the present study's sample versus national data from over 4,000 children aged 2-12 years in the NHANES 1999-2002. Tables 16-18 provide descriptive data on BMI, energy intakes, and physical fitness scores based on gender, ethnicity, and grade level.

Table 11

Most Frequently Consumed RTECs Among the 5th Grade Students and Fiber Content Per Serving

Brand Name of RTEC	% of Sample	Gram(s) of Fiber (per NLEA serving)*
Cocoa Puffs ®	13.9	1 (¾ cup)
Lucky Charms®	13.5	1 (¾ cup)
Froot Loops®	9.8	<1 (1 cup)
Frosted Flakes®	9.5	1 (¾ cup)
Cheerios®	8.4	3 (1 cup)
Kix®	6.2	3 (1 ¼ cup)
Cinnamon Toast Crunch®	5.6	1 (¾ cup)
Golden Grahams®	4.4	1 (¾ cup)
Corn Flakes®	3.7	1 (1 cup)
Unknown Type	3.7	3 (1 cup)

*Nutrition Labeling and Education Act Serving Based on Manufacturer's Nutrition Label and NDS-R

Table 12

Most Frequently Consumed RTECs Among the 6th Grade Students and Fiber Content Per Serving

Brand Name of RTEC	% of Sample	Gram(s) of Fiber (per NLEA serving)*
Frosted Flakes®	9.9	1 (¾ cup)
Froot Loops®	7.8	<1 (1 cup)
Cocoa Puffs®	7.5	1 (¾ cup)
Lucky Charms®	7.5	1 (¾ cup)
Cheerios®	7.0	3 (1 cup)
Honey Nut Cheerios®	7.0	2 (1 cup)
Trix®	6.5	1 (1 cup)
Honey Comb®	4.0	2 (1 ½ cup)
Unknown Type	4.0	3 (1 cup)
Corn Flakes®	3.5	1 (1 cup)

*Nutrition Labeling and Education Act Serving Based on Manufacturer's Nutrition Label and NDS-R

Table 13

*Most Frequently Consumed RTECs Among the 5th Grade and 6th Grade Students and Percentages of Daily Values of Nutrients**

RTEC Brand Name (per NLEA serving)	Calcium DV (%)**	Magnesium DV (%)	Iron DV (%)	Vitamin A DV (%)	Vitamin C DV (%)
Cocoa Puffs® (¾ cup)	10	2	25	10	10
Lucky Charms® (¾ cup)	10	2	25	10	10
Froot Loops® (1 cup)	0	2	25	10	25
Frosted Flakes® (¾ cup)	0	1	25	10	10
Cheerios® (1 cup)	10	10	45	10	10
Kix® (1 ¼ cup)	15	4	45	10	10
Cinnamon Toast Crunch® (¾ cup)	10	2	25	10	10
Golden Grahams® (¾ cup)	10	2	25	10	10
Corn Flakes® (1 cup)	0	1	45	10	10
Honey Nut Cheerios® (1 cup)	10	8	25	10	10
Trix® (1 cup)	10	2	10	10	10
Honey Comb® (1 ½ cup)	0	6	15	15	0

* Nutrition Labeling and Education Act Serving Based on Manufacturer's Nutrition Label
**% Daily Value is based on a 2,000 calorie diet

Table 14

Non-RTEC and RTEC Breakfast Consumption by Grade Level and Location

Meal Type	Grade Level	Home (%)	School (%)	Restaurant (%)
Non-RTEC Breakfast	5th	32.8	22.8	<1.0
RTEC Breakfast	5th	22.5	21.0	<1.0
Non-RTEC Breakfast	6th	40.5	18.1	4.0
RTEC Breakfast	6th	25.7	11.7	0.0

Table 15

Top Ten Most Frequently Consumed Breakfast Foods

Ranking	NHANES, 1999-2002	Bienestar Control Group
1	Milk	Milk
2	RTEC	Juice
3	White bread	RTEC
4	Juice	Eggs
5	Eggs	Tortilla
6	Meat	Biscuit
7	Fruit	White bread
8	Breakfast pastries, donuts, granola bars	Taco
9	Cooked cereal	Sausage
10	Pancakes	Refried beans

Table 16

Body Mass Index, Energy Intake, and Physical Fitness Scores by Gender and Ethnicity Among 4th Grade Students

Outcome or Control Variable	Recommended For Boys	Boys n=309	Recommended For Girls	Girls n=315	Total n=624	Hispanic Children n=487	White Children n=39	African American Children n=74	Other Ethnicity Children n=24
Body Mass Index (Mean ± SD)	16.2[a]	20.53± 4.89	16.4[a]	20.26± 4.75	20.39± 4.82	20.41± 4.77	20.77± 5.08	20.47± 5.09	19.06± 4.76
Energy Intake (Kcal± SD)	1,600-2,200[b]	1,688.59± 534.67	1,400-2,000[b]	1,550.66± 547.80	1,618.96± 545.29	1,599.50± 526.12	1,540.79± 560.82	1,769.81± 660.12	1,673.31± 457.84
Physical Fitness Score (Mean± SD)	Marginally Acceptable[c] 65-79 Unacceptable 0-64	67.86± 13.18	Marginally Acceptable[c] 65-79 Unacceptable 0-64	63.56± 13.42	65.69± 13.47	65.95± 13.28	61.62± 15.39	67.28± 12.09	62.02± 16.77

[a]Based on the Centers for Disease Control and Prevention growth chart 50th percentile
[b]Based on USDA MyPyramid Food Intake Pattern Calorie Levels
[c]Keen & Sloan, 1958

Table 17

Body Mass Index, Energy Intake, and Physical Fitness Scores by Gender and Ethnicity Among 5th Grade Students

Outcome or Control Variable	Recommended For Boys	Boys n=288	Recommended For Girls	Girls n=289	Total n=577	Hispanic Children n=453	White Children n=27	African American Children n=73	Other Ethnicity Children n=24
Body Mass Index (Mean ± SD)	17.0[a]	22.25± 5.68	17.2[a]	22.03± 5.41	22.14± 5.55	22.24± 5.45	22.19± 5.51	21.87± 6.22	21.11± 5.52
Energy Intake (Kcal± SD)	1,600-2,200[b]	1,837.31± 622.18	1,400-2,000[b]	1,729.35± 575.49	1,783.23± 601.16	1,729.43± 579.29	1,927.25± 775.72	2,022.57± 647.87	1,908.88± 426.50
Physical Fitness Score (Mean± SD)	Marginally Acceptable[c] 65-79 Unacceptable 0-64	70.67± 14.13	Marginally Acceptable[c] 65-79 Unacceptable 0-64	64.44± 13.96	67.55± 14.38	67.47± 14.64	68.80± 12.87	67.62± 13.88	67.42± 13.08

[a]Based on the Centers for Disease Control and Prevention growth chart 50th percentile
[b]Based on USDA MyPyramid Food Intake Pattern Calorie Levels
[c]Keen & Sloan, 1958

Table 18

Body Mass Index, Energy Intake, and Physical Fitness Scores by Gender and Ethnicity Among 6th Grade Students

Outcome or Control Variable	Recommended For Boys	Boys n=248	Recommended For Girls	Girls n=240	Total n=488	Hispanic Children n=387	White Children n=21	African American Children n=61	Other Ethnicity Children n=19
Body Mass Index (Mean ± SD)	17.5[a]	23.43± 6.07	17.8[a]	23.36± 5.70	23.39± 5.88	23.61± 5.88	23.58± 6.78	22.24± 5.43	22.53± 6.29
Energy Intake (Kcal± SD)	1,800-2,400[b]	1,933.51± 739.08	1,600-2,200[b]	1,712.90± 636.51	1,825.01± 698.62	1,790.60± 663.94	1,958.22± 665.03	1,966.79± 826.40	1,923.43± 927.06
Physical Fitness Score (Mean± SD)	Marginally Acceptable[c] 65-79 Unacceptable 0-64	69.01± 12.69	Marginally Acceptable[c] 65-79 Unacceptable 0-64	61.15± 12.42	65.15± 13.15	64.94± 12.95	63.70± 14.36	67.04± 13.45	64.94± 15.32

[a]Based on the Centers for Disease Control and Prevention growth chart 50th percentile
[b]Based on USDA MyPyramid Food Intake Pattern Calorie Levels
[c]Keen & Sloan, 1958

CHAPTER V

DISCUSSION AND CONCLUSIONS

Summary of Test Hypotheses

The purpose of this study was to determine if there was an association between the frequency of eating breakfast and BMI in a sample of predominantly Hispanic children at their 4th, 5th, and 6th grade years. A second purpose was to determine if there was an association between the frequency of eating ready-to-eat (RTEC) and BMI in a sample of predominantly Hispanic children at their 4th, 5th, and 6th grade years. The third purpose was to determine if there was an association between the frequency of eating RTEC and nutrient intakes of calcium, magnesium, iron, vitamin A, vitamin C, and fiber in a predominantly Hispanic sample of children at their 4th, 5th, and 6th grade years.

This study was designed to test the following null hypotheses:

1. The frequency of eating breakfast will have no significant association with BMI among students in the control group of the Bienestar Program controlling for age, gender, ethnicity, energy intake, and physical fitness at their 4th, 5th, and 6th grade years.

   FAILED TO REJECT: There was no significant association between the frequency of breakfast and BMI among students in the control group of the Bienestar Program at their 4th, 5th, and 6th grade years.

2. The frequency of eating RTEC will have no significant association with BMI among students in the control group of the Bienestar Program controlling for age, gender, ethnicity, energy intake, and physical fitness at their 4th, 5th, and 6th grade years.

   REJECTED: There was a significant r^2 change in the predictor (R= .488), RTEC consumption, after controlling for age, gender, ethnicity, energy intake, and physical fitness; the more days of RTEC consumption resulted in a decreased BMI at the 4th grade year.

3. The frequency of eating RTEC will have no significant association with nutrient intakes of calcium, magnesium, iron, vitamin A, vitamin C, and fiber among students in the control group of the Bienestar Program controlling for age, gender, ethnicity, energy intake, and physical fitness at their 4th, 5th, and 6th grade years.

   REJECTED: There was a significant r^2 change when nutrients were predicted by RTEC consumption, after controlling for age, gender, ethnicity, energy intake, and physical fitness. The relationship between RTEC and the nutrient was positive; the more days of RTEC consumption resulted in increased intakes of nutrients. During the 4th grade, RTEC was positively related to calcium (R=.685), magnesium (R=.839), iron (R=.836), vitamin C (R=.441). During the 5th grade, RTEC was positively related to calcium (R=.677), magnesium (R=.866), iron (R=.845), and vitamin A (R=.476). During the 6th grade, RTEC was positively related to calcium (R=.701), magnesium (R=.845), and iron (R=.850).

Discussion

Breakfast and BMI

This study provided cross-sectional findings over a three-year period of a predominantly Hispanic sample of students from a low socioeconomic status school district in San Antonio, Texas. There was no significant association between the frequency of breakfast and BMI among students in the control group of the Bienestar Program at their 4th, 5th, or 6th grade years. Several previous studies have indicated an inverse association between breakfast frequency and BMI or body weight (Affenito et al., 2005; Barton et al., 2005; Berkey, Rockett, Gillman, Field, & Colditz, 2003; Dwyer et al., 2001; Niemeier, Raynor, Lloyd-Richardson, Rogers, & Wing, 2006; Roseman, Yeung, & Nickelsen, 2007; Utter, Scragg, Mhurchu, & Schaaf, 2007; Vanelli et al., 2005). However, not all studies have supported these findings. A study of 3,007 Australians aged 2-18 years found no association between breakfast frequency and BMI (Williams, 2007). There was no association between breakfast frequency and BMI among a sample of 84 Saudi Arabian school students (Abalkhail & Shawky, 2002). There was no association between breakfast frequency and body weight among 1,151 low-income African American children in the 2nd through 5th grades at four elementary schools in New Jersey and among 4,717 adolescents aged 16-18 years in South Africa (Sampson, Dixit, Meyers, & Houser, 1995; Walker, Walker, Jones, & Ncongwane, 1982). One reason for this discrepancy may be the method of obtaining body weight measurements. Some studies used self-report methods while others used trained staff to collect measurements. There were also differences in the outcome measurement of BMI versus body weight. BMI may also have been categorical, using at risk for overweight and overweight as categories. Also, not all studies controlled for confounding variables. Another discrepancy may be that obese individuals may underreport their food intake, and therefore may possibly underreport their breakfast intake too (Bandini, Schoeller, Cyr, & Dietz, 1990).

The present study controlled for confounding variables such as age, gender, ethnicity, energy intake, and fitness level; however, possibly using BMI as a categorical variable measure such as normal weight, at risk for overweight, or overweight may have provided different results.

The definition and measurement of breakfast varied without a rationale usually being offered. This present study used three 24-hour recalls (2 weekdays and 1 weekend day) and the consumption of breakfast was defined by student's self reporting. The recalls were collected on 3 separate site visits so the participant only had to recall one day's diet intake at a time. Four other previous studies have used 24-hour recalls (Affenito et al., 2005; Barton et al., 2005; Dwyer et al., 2001; Sampson, Dixit, Meyers, & Houser, 1995). Dwyer et al. (2001) and Sampson, Dixit, Meyers, and Houser (1995) followed the present study's protocol of defining breakfast by utilizing the student's self-reporting; therefore, each student reported when and what they ate for breakfast; however, only one 24-hour recall was collected. Dwyer et al. (2001) found a negative association between breakfast consumption and body weight while Sampson, Dixit, Meyers, and Houser (1995) did not find an association between breakfast consumption and body weight. Interestingly, Sampson, Dixit, Meyers, and Houser (1995) collected a

24-hour diet recall and a "Morning Eating Behavior Survey." The survey was self-administered on four random days over a two week period and it asked "Did you have anything to eat before coming to school?" and "Did you eat a snack on the way to school?" These children did not have access to the School Breakfast Program when the survey was taken so if they did not eat prior to arriving at school then they did not eat breakfast. Six hundred children completed the survey on all four days and 1,151 children completed the 24-hour diet recall. The survey found 4% of the children did not eat breakfast on all four survey days and the recall found 12% did not eat breakfast. Affenito et al. (2005) and Barton et al. (2005) defined breakfast using three 24-hour diet recalls that included 2 weekdays and 1 weekend day that is aligned with the present study's protocol. However, they defined breakfast based on the time of day and established cut-offs for breakfast as eating between 5:00am to 10:00am on weekdays and 5:00am to 11:00am on weekends. Some studies used food frequencies to assess breakfast consumption instead of 24-hour diet recalls. These studies typically inquired about breakfast consumption during a one-week timeframe. However, the responses were collected in different formats and then often categorized differently. For example, Roseman, Yeung, & Nickelsen (2007) asked "How many days did you eat breakfast during the past 7 days?" There were 8 responses that ranged from "none" to "all 7 days." The researchers then collapsed the categories into "did not consume," "1-3 days in the past week," "4-6 days in the past week," and "every day." Timlin, Pereira, Story, & Neumark-Sztainer (2008) asked the same question, "During the past week, how many days did you eat breakfast?" The responses were never, 1-2 days, 3-4 days, 5-6 days, and every day. These responses were then categorized following this format: never= "daily breakfast skipper," 1-6 days= "intermittent breakfast eater," and every day= "daily breakfast eater." Niemeier, Raynor, Lloyd-Richardson, Rogers, & Wing (2006) asked the same question, "In the last 7 days, on how many days did you eat breakfast?" However, they did not categorize the responses; instead the responses were reported as continuous, for example, the responses ranged from 0 day to 7 days. Berkey, Rockett, Gillman, Field, & Colditz (2003) asked "How many times each week (including weekdays and weekends) do you eat breakfast?" The responses were: never or almost never, 1-2 times per week, 3-4 times per week and 5 or more times per week. Utter, Scragg, Mhurchu, & Schaaf (2007) asked "Over the past week, did you eat or drink something before you left home for school in the morning?" The responses were "yes, usually," "yes, sometimes," or "no." Since there were few "no" responses, the researchers categorized the responses into "usually=regular breakfast eater" and "sometimes/none=breakfast skipper." Overall, the frequencies typically asked about a typical week's breakfast consumption in slightly different formats. The difference lies in how the responses were categorized and each study chose a different format to report typical breakfast consumption. There is not another study to date that has followed the exact protocol as the present study. One study that used 24-hour diet recalls based breakfast consumption on one day and may not have captured the typical consumption pattern for that child (Affenito, 2007). Two studies that used 24-hour diet recalls had three days of diet intake; however, the researchers defined breakfast differently using the time of day and not student's self-reporting. Nevertheless, there are several reasons for the lack of consistency of findings among studies such as the definition of breakfast that may be responsible for the lack of association between breakfast and BMI in this study as well.

The present study did not find a significant association between the frequency of breakfast and BMI. This may be due to the method of reporting BMI. Possibly utilizing a categorical measure instead of a continuous measure of BMI would have yielded different results. The majority of previous studies reported breakfast intake using a food frequency survey, instead of the 24-hour diet recall. Possibly the utilization of a food frequency may yield different results. According to the General Mills Bell Institute of Health and Nutrition (2007), breakfast skipping ranges from 10-30% depending on the age group, population, and definition; 14% of 6-12 year olds skip breakfast according to NHANES 1999-2002 compared to a lower rate of skipping breakfast found in the present study of 2.2% in the 4th grade, 4.7% in the 5th grade, and 7.2% in the 6th grade. The differences in breakfast skipping and consumption frequency among previous studies that found an inverse relationship between breakfast and BMI compared to the present study may also contribute to the lack of association. There is also the possibility that among this sample of predominately Hispanic children from low-income households that no significant relationship exists between the frequency of breakfast and BMI, regardless of methodology.

RTEC and BMI

In this study, the frequency of eating breakfast did not predict a lower BMI; however, it was more important to know if the child chose RTEC for breakfast. There was a significant association between the frequency of RTEC and BMI among students at their 4th grade year. However, there was no association at their 5th and 6th grade years. Previous studies have shown a decline in the frequency of breakfast consumption as children and adolescents age; breakfast skipping increased from 6.5% (4-8 year olds) to 20.5% (9-13 year olds) to 36.1% (14-18 year olds) (Cleveland, Goldman, & Borrud, 1994; Song et al., 2006). There was an increase in the number of students that skipped breakfast in the present study as well from 2.2% in the 4th grade to 4.7% in the 5th grade to 7.2% in the 6th grade (Table 6). This present study had similar percentages of breakfast skipping among the 6th grade students; however, the percentages of breakfast skipping in the 4th and 5th grades were lower compared to previous studies. The lower percentages of breakfast skipping may be due to a previous finding that Hispanic elementary students from low-income households are more likely to participate in the School Breakfast Program (Kennedy & Davis, 1998). The 1994-1996 Continuing Survey of Food Intakes (CSFII) Survey reported breakfast consumption was higher among 6-11 year old children, 92.9% among males and 91.6% among females. Therefore, breakfast skipping was 7.1% among males and 8.4% among females. The more recent NHANES 2001-2002 data indicated 13% of males and 14% of females aged 6-11 years did not eat breakfast. And 31% of males and 30% of females aged 12-19 years did not eat breakfast.

Another study examined breakfast consumption based on 3 days of dietary recalls. The sample was large and included 1,166 White and 1,213 African American girls. However, the data was collected based on age and not grade level over a ten year period. There was a significant racial difference reported with White girls consuming breakfast with greater frequency than African American girls did on all three days measured, with the greatest racial difference occurring at 12 years of age (Table 18).

Table 18

Frequency of Breakfast Consumption by Age in White and African American Girls (Based on 3 Days of Dietary Recalls)

	White Girls				African American Girls			
	Days of Eating Breakfast				Days of Eating Breakfast			
Age (y)	0	1	2	3	0	1	2	3
9	0.9	3.9	18.5	76.7	2.5	11.6	28.7	57.2
10	0.8	4.4	18.4	76.4	3.3	12.0	30.2	54.5
11	2.4	7.7	23.9	66.1	4.3	16.9	30.1	48.7
12	3.0	11.0	23.4	62.5	10.2	21.1	30.3	38.4

Affenito et al. (2005)

The present study's results were similar to this trend seen with African American girls in the study by Affenito et al. (2005). Overall, the present study had an increase in the percentage of no breakfast days from the 4th (2.2%) to the 5th (4.7%) to the 6th grade (7.2%). The percentage of one day of breakfast consumption increased from the 4th (9.1%) to the 5th (15.6%) to the 6th grade (22.1%). The percentage of two days of breakfast consumption increased slightly from the 4th (24.4%) to the 5th (24.8%) to the 6th grade (29.7%). The percentage of three days of breakfast consumption decreased from the 4th (64.3%) to the 5th (54.9%) to the 6th grade (41%). There does appear to be an ethnic difference in breakfast consumption. Song et al. (2005) reported breakfast consumption was highest among Whites (80.4%) compared to African Americans

(68.7%) and Hispanics (68.7%). Videon and Manning (2008) found contrasting results among 18,177 adolescents (mean age 15.9 years), African American and Hispanic teenagers were less likely to skip breakfast than their White peers. The Bogalusa Heart Study found conflicting results that indicated 10-year old African American children skipped breakfast more often (24%) than White children (13%) (Nicklas, O'Neil, & Berenson, 1998). The difference in breakfast consumption patterns among ethnicities has not been established and warrants further investigation.

In the present study, the percentage of students choosing foods other than RTEC for breakfast increased each year from 32.3% in the 4th grade year to 36.7% in the 5th grade year to 44.2% in the 6th grade year. The children who were still eating breakfast were choosing foods other than RTEC. Table 15 presents the top ten most frequently consumed foods for breakfast among the Bienestar control group versus a national sample of children aged 2-12 years from NHANES 1999-2002. The five foods that were common among both samples were milk, juice, RTEC, eggs, and white bread. However, the Bienestar control group that included mostly Hispanic children consumed traditional Mexican foods such as tortillas, tacos, and refried beans for breakfast. The lack of association in the 5th and 6th grade years may have been due to the shift in consumption patterns of breakfast and RTEC. Barton et al. (2005) also reported this pattern with cereal consumption decreasing significantly as a sample of 1,015 girls grew older. The mean days of cereal consumption (based on 3 diet recalls) decreased from 1.5 days at 9 years of age to 0.9 day at 19 years of age. The mean days of cereal consumption decreased from 1.5 at 9 years of age to 1.4 at 10 years of age to 1.3 at 11 years of age to

1.2 at 12 years of age. In the present study, the mean days of RTEC consumption decreased from 1.2 in the 4th grade to 1.0 in the 5th grade to 0.8 in the 6th grade. These results provide a frame of reference; however, it is problematic to compare the results since the sample used by Barton et al. (2005) included females only and the cereal consumption included both RTEC and cooked cereal such as oatmeal.

The association between RTEC consumption and reduced BMI may be due to several possible factors. Routine breakfast consumption may be a marker of healthy eating or lead to more regular eating habits and exercise patterns, and consistent energy intake that collectively may contribute to a lower BMI (Affenito et al., 2005; Giovanni et al., 2008; Rampersaud, 2009; Timlin, Pereira, Story, & Neumark-Sztainer, 2008). Breakfast skipping may be related to unhealthy behaviors such as less physical activity thereby contributing to positive energy balance and weight gain (Keski-Rahkonen, Kaprio, Rissanen, Virkkunen, & Rose, 2003; Rampersaud, Pereira, Girard, Adams, & Metzl, 2005; Song et al., 2005). Breakfast skipping has also been associated with eating more foods that are low in nutrients such as fast foods (Niemeier, Raynor, Lloyd-Richardson, Rogers, & Wing, 2006). A healthy weight among middle-school students in Kentucky was associated with consuming fruits, vegetables, breakfast, and milk (Roseman, Yeung, & Nickelsen, 2007). An increased intake of fruits and vegetables is associated with a reduced risk of type 2 diabetes and stroke and possibly other cardiovascular diseases, as well as a reduced risk of cancers in certain sites (oral cavity and pharynx, larynx, lung, esophagus, stomach, and colon-rectum) (USDA, 2005). The recommended daily intake of three servings (equivalent to 3 cups) of milk and milk products each day can reduce the risk of low bone mass and contribute important amounts of essential nutrients. Additionally, this daily milk product consumption may have additional health benefits and is not associated with increased body weight (USDA, 2005).

The amount of sugar in RTEC may raise some concern. According to NHANES 2001-2002 data, RTEC, including presweetened cereals, contributes 5.1% of sugar to the diets of children aged 4-12 years. Over 40% of sugar in children's diets is from foods that are not providing other essential nutrients along with the calories. Barton et al. (2005) reported cereal eaters were leaner than non-cereal eaters and 41% of the cereals eaten in the Barton et al. study were presweetened. According to the Dietary Guideline Technical Advisory Report (2005), sugar added to nutrient-dense foods like cereal and milk products, may improve palatability, thereby increasing intakes of essential nutrients.

Cereal consumption, including RTEC, may be a marker of an overall healthy lifestyle (Albertson et al., 2003; Albertson et al., 2008; Barton et al., 2005). Albertson et al. (2003) found that children who ate RTEC most frequently were children who most often ate breakfast. Breakfast consumption, specifically RTEC consumption, may indicate eating patterns that are more favorable for weight maintenance. Cereal consumption is related to increased physical activity that may then be responsible for a lower BMI (Albertson et al., 2008). It is possible that a breakfast including RTEC may provide satiety and prevent consumption of less nutrient-rich foods later in the day. Since RTEC is typically lower in fat than other breakfast options, fat intakes have been lower in adults and children who eat RTEC (Stanton & Keast, 1989; Albertson &

Tobelmann, 1992; Nicklas, O'Neil, & Berenson, 1998). A lower fat intake may help maintain a favorable energy balance and ultimately a favorable BMI. High intakes of fat (> 35 percent of energy) increase the risk for obesity and coronary heart disease. A fat intake greater than 35% of energy has been associated with both increased calorie and saturated fat intakes (USDA, 2005). If RTEC consumption is associated with these healthy eating and physical activity behaviors, then it may be a potential marker of healthy eating. The present study did not consider the amount of physical activity; however, fitness index was utilized to assess physical fitness. Physical fitness index instead of physical activity was assessed because activity recall questionnaires in children younger than ten years of age are less reliable and valid than those in older children (Sallis, Buono, Roby, Micale, & Nelson, 1993; Saris, 1986).

Overall, the frequency of RTEC consumption did predict a lower BMI among this sample of elementary-aged children. This finding reinforces the importance of including RTEC at breakfast time as a way to help children, especially Hispanic children from low-income households, maintain a healthy BMI.

RTEC and Micronutrients

The present study found RTEC did contribute significantly to micronutrient intakes. Intakes of calcium, magnesium, and iron were significantly related to the frequency of RTEC consumption in the 4th, 5th, and 6th grades. Vitamin C intake was significantly related to RTEC consumption in the 4th and 5th grades. And vitamin A intake was significantly related to RTEC consumption in the 5th grade. The Continuing Survey of Food Intakes for 2-18 year olds also indicated that RTEC is among the top contributors to the diet of vitamin A, vitamin C, iron, folate, and zinc (Subar, Krebs-Smith, Cook, & Kahle, 1998). Albertson et al. (2008) stated that cereal itself offered more micronutrients, relative to foods other than cereal, eaten during breakfast. Cereal consumption may facilitate the intake of other healthful foods at breakfast and displace less healthful foods (Albertson et al., 2008).

RTEC and Calcium

RTEC at breakfast is often eaten with milk that may contribute to the intake of calcium (Rampersaud, 2009). The intake of milk and therefore calcium decreases as children grow, especially in their adolescent years (Bowman, 2002). Adolescent years are a critical bone-building time to accumulate peak bone mass and therefore, the lack of calcium intake is particularly troubling. Milk is an essential source of calcium with an 8 ounce serving providing 30% of the Daily Value of calcium; however, it also provides other key nutrients such as vitamin D, protein, potassium, vitamin A, vitamin B12, riboflavin, niacin, and phosphorus (National Dairy Council, 2004). Milk is the number one source of calcium, magnesium, and vitamin A in diets of children aged 2-18 years (United States Department of Health and Human Services and USDA, 2005). Nine out the 12 most commonly consumed RTEC in this study provided 10% of the Daily Value of calcium (Table 13). The USDA (2005) has identified calcium as a "nutrient of concern," meaning that this nutrient is usually consumed in low enough amounts to warrant special attention. According to the American Academy of Pediatrics report, children need three servings of milk or milk products daily, and adolescents need four servings daily to meet calcium recommendations (Greer & Krebs, 2006). An adequate intake of calcium during childhood and adolescence is critical for the body to reach peak bone mass which may reduce the risk of fractures and osteoporosis later in life (Greer & Krebs, 2006). A study of 200 girls aged 3 to 15 years found lower calcium intake was reported for those with fractures compared to control subjects (Goulding et al., 1998). A four-year follow-up of these same girls (n=170) found a continued risk of fracture in girls with lower calcium intake (Goulding, Jones, Taylor, Manning, & Williams, 2000). Calcium intake, specifically from dairy foods like milk, has been negatively associated with children's BMIs (Barba, Troiano, Russo, Venezia, & Siani, 2005; Moreira, Padez, Mourao, & Rosado, 2004; Rockell et al., 2005; Skinner, Bounds, Carruth, & Ziegler, 2003). A significant inverse association between calcium intake from dairy foods and body fat among children and adolescents has also been observed (Moore, Singer et al., 2003; Moore, Singer, Bradlee, & Ellison, 2004; Moore, Singer, Qureshi, & Bradlee, 2008; Novotny, Daida, Acharya, Grove, & Vogt, 2004; Olivares et al., 2004). Since 71% of girls and 62% of boys aged 6 to 11 years do not meet the recommended intake of calcium, RTEC may facilitate the consumption of milk, thereby, possibly increasing not only the intake of calcium but also vitamin A and magnesium (Alaimo et al., 1994).

Overall, RTEC consumption did increase the intake of calcium among this sample of predominately Hispanic children from low-income households. However, even with the inclusion of RTEC in the children's diets, daily calcium intake was still below the Dietary Reference Intake (Tables 8-10). The benefits of an adequate calcium intake among these children include establishing peak bone mass and reducing fracture rates (Goulding et al., 1998; Goulding, Jones, Taylor, Manning, & Williams, 2000; Greer &

Krebs, 2006). An inverse association has been observed between calcium intake and BMI as well as body fat in children and Hispanic children are at a greater risk of overweight and type 2 diabetes. Therefore, promoting an adequate intake of calcium via RTEC consumption may prove beneficial (Barba, Troiano, Russo, Venezia, & Siani, 2005; Moore, Singer et al., 2003; Moore, Singer, Bradlee, & Ellison, 2004; Moore, Singer, Qureshi, & Bradlee, 2008; Moreira, Padez, Mourao, & Rosado, 2004; Novotny, Daida, Acharya, Grove, & Vogt, 2004; Olivares et al., 2004; Rockell et al., 2005; Skinner, Bounds, Carruth, & Ziegler, 2003). Additional methods of increasing the Dietary Reference Intake should be explored that are economical and easily accessible foods such as fortified cereal bars.

RTEC and Magnesium

Magnesium intake was significantly increased among the students who ate RTEC for breakfast. Magnesium is essential for growth in children and is responsible for participating in numerous bodily functions and contributing to establishing optimal bone density (IOM, 1997). Magnesium is also an important cofactor for enzymatic reactions involved in metabolism of carbohydrates. Huerta et al. (2005) found an association between magnesium deficiency and insulin resistance during childhood. Magnesium intake may be inversely related to risk of hypertension and type 2 diabetes among adults and higher magnesium intakes may decrease concentrations of blood triglycerides and increase high-density lipoprotein cholesterol (He et al., 2006; Murakami, Okubo, & Sasaki, 2005; Schulze et al., 2007; Song, Manson, Buring, & Liu, 2004; van Dam, Hu, Rosenberg, Krishnan, & Palmer, 2006). The USDA (2005) has identified magnesium as a "nutrient of concern," meaning that this nutrient is usually consumed in low enough amounts to warrant special attention.

Overall, RTEC consumption significantly increased magnesium intake among this predominately Hispanic sample of children from low-income households. Milk as a partner food to RTEC provides magnesium; a ½ cup serving of milk provides 4% of the Daily Value of magnesium. Four of the 12 most commonly consumed RTECs provided at least 4% of the Daily Value of magnesium (Table 13). However, even with the inclusion of RTEC in the children's diets, daily magnesium intake was still below the Dietary Reference Intake (Tables 8-10). A sufficient magnesium intake is essential for adequate growth and maximizing bone density and an inadequate intake has been related to insulin resistance and type 2 diabetes as well as hypertension and an unfavorable blood lipid profile (He et al., 2006; Huerta et al., 2005; IOM, 1997; Murakami, Okubo, & Sasaki, 2005; Schulze et al., 2007; Song, Manson, Buring, & Liu, 2004; van Dam, Hu, Rosenberg, Krishnan, & Palmer, 2006). Hispanic children are at a greater risk of being overweight and developing type 2 diabetes, therefore, an adequate magnesium intake may play a protective role among these children (Cruz & Goran, 2004; Hedley et al., 2004; Pontiroli, 2004).

RTEC and Iron

Forty different RTECs offered 10-100% of the reference daily intake of iron or about 1.8-18 mg (Johnson, Smith, & Edmonds, 1998). In 1941, iron, thiamin, riboflavin, and niacin were added to enrich flours to the 100% whole grain level. Then in 1956, the first cereal fortified with iron and vitamins beyond the whole-grain restoration level was introduced. Most manufacturers fortify RTECs with levels of iron ranging from 8-100%, and there are few cereals without fortification (Whittaker, Tufaro, & Rader, 2001). Eleven out of the 12 most commonly consumed RTECs provided at least 25% of the Daily Value of iron (Table 13).

Iron deficiency affects 2.4 million American children, and childhood iron-deficiency anemia is associated with behavioral and cognitive delays (Brotanek, Gosz, Weitzman, & Flores, 2007). Iron is an essential nutrient required for the production of hemoglobin that is responsible for carrying oxygen to the red blood cells. The red blood cells in turn deliver oxygen throughout the body to all cells. When there is an iron deficiency, the body is not able to produce an adequate amount of red blood cells and the body's organs and tissues will not be able to receive the necessary oxygen (CDC, 2007). Children with iron deficiency severe enough to cause anemia were academically disadvantaged; however, their cognitive ability improved with iron therapy (Taras, 2005). The prevalence of iron deficiency was higher in Hispanic children (12%) than White (6%) and African American children (6%) (Brotanek, Gosz, Weitzman, & Flores, 2007).

Overall, RTEC consumption did significantly increase iron intake among this predominately Hispanic sample of children from low-income households. Hispanic children are at greater risk of iron deficiency; therefore, the routine consumption of RTEC may help decrease the risk.

RTEC and Vitamin A

Vitamin A plays an important role in vision, bone growth, and immune system regulation (National Institutes of Health, 2006). In this present study, the consumption of RTEC was positively associated with vitamin A intake. Milk is a partner food to RTEC and a ½ cup serving of milk provides 5% of the Daily Value of vitamin A. All of the twelve most commonly consumed RTECs provided at least 10% of the Daily Value of vitamin A (Table 13). Vitamin A intake was significantly associated with RTEC consumption for the 5th grade students only. This may have been due to changes in the student's consumption pattern possibly attributed to the change from elementary school (5th grade) to middle school (6th grade). Most children were eligible for free or reduced school meals. The National School Breakfast Program must provide 25% of the Recommended Daily Allowance for vitamin A (USDA, 2008). However, the present study did not track actual participation in the breakfast and lunch programs. As children graduated from elementary (5th grade) to middle school (6th grade), their school meal program participation decreased for both RTEC and non-RTEC breakfasts possibly affecting their intakes of vitamin A that would have been provided by school meals.

Overall, RTEC consumption did increase the intake of vitamin A among this predominately Hispanic sample of children. Hispanic, specifically Mexican American, children were found to have a high prevalence of subclinical deficiency of vitamin A (retinol > 10 and < 20 micrograms/dl) (Villalpando et al., 2003). Given this fact, it is prudent to promote RTEC as a breakfast food to increase the likelihood of these children getting an adequate vitamin A intake.

RTEC and Vitamin C

Vitamin C is a water-soluble antioxidant and is a cofactor for numerous enzymes involved in the biosynthesis of collagen, carnitine, and neurotransmitters (IOM, 2000). Hampl, Taylor, and Johnston (1999) reported 12% of boys and 13% of girls aged 7 to 12 years had mean vitamin C intakes that were less than 30 mg per day, well below the DRI of 45 mg per day. Children with adequate vitamin C intakes also consumed significantly more energy-adjusted folate and vitamin B12. Children with low vitamin C intakes consumed significantly more fat and saturated fat. The researchers stated that children with desirable vitamin C intakes had overall healthier diets that included more milk and vegetables versus children with low vitamin C intakes (Hampl, Taylor, & Johnston, 1999). The present study found that RTEC consumption for breakfast was positively related to vitamin C intake. All of the twelve most commonly consumed RTECs provided at least 10% of the Daily Value of vitamin C (Table 13). Nearly all RTECs are fortified with vitamin C. Breakfast consumption should incorporate RTEC as a way to increase the intake of vitamin C.

The shift in vitamin C intake from the 4th and 5th grades to the 6th grade may be due to changes in the student's consumption pattern possibly attributed to the change from elementary school to middle school. Most children were eligible for free or reduced school meals. The National School Breakfast Program must provide 25% of the Recommended Daily Allowance for energy, protein, calcium, iron, vitamin A, and vitamin C (USDA, 2008). However, their actual participation in the breakfast and lunch programs was not tracked. It may be possible that as children graduated from elementary to middle school, their school meal program participation decreased; thereby affecting their intakes of vitamin C that would have been provided by school meals.

Another possibility for the shift in nutrient intake may be related to consumption of fruit and 100% fruit juice; these are important sources of vitamin C, folate, magnesium, potassium, and fiber (USDA, 2005). Children who eat breakfast at home or at school eat more fruit than children who skip breakfast (Basiotis, Lino, & Anand, 1999). One-hundred percent fruit juice such as orange and grapefruit are especially nutrient-dense and are excellent sources of vitamin C (Rampersaud, 2007). The association between RTEC and vitamin C intake at the 4th and 5th grades may be due to the inclusion of fruit or fruit juices since these are important sources of vitamins C and A (Newby, 2007).

Overall, the frequency of RTEC consumption did increase the intake of vitamin C among this predominately Hispanic sample of children from low-income households. A previous study found that the likelihood of vitamin C deficiency was less in Hispanic children, specifically Mexican American, as socioeconomic level increased (Villalpando et al., 2003). The children in this present study came from low-income households and may be at risk for not meeting their vitamin C requirements, therefore, the promotion of RTEC as part of nutrient-rich breakfast may help facilitate the intake of vitamin C.

RTEC and Fiber

Ready-to-eat cereal is the top contributor of whole grains to the diet among children and adolescents aged 2-18 years (Harnack, Walters, & Jacobs, 2003). However, there was not a significant association between RTEC and fiber intake in this study that may be due to the choice of the particular RTEC. The RTEC chosen was typically lower in fiber such as Frosted Flakes®, Lucky Charms®, and Froot Loops® versus those cereals higher in fiber such as Raisin Bran®, Total®, or Frosted Mini-Wheats®. Ten of the 12 most commonly consumed RTECs provided 2 or less grams of fiber (Table 13). The inclusion of RTEC with more fiber than the most commonly consumed RTEC in this study may help increase daily fiber intakes. However, this will be a challenge since these cereals are competing with the presweetened cereals.

Limitations and Strengths

The cross-sectional and observational nature of this study does not indicate causality. Therefore there is not a causal link between breakfast and RTEC consumption with BMI and micronutrient intakes.

During the data screening process, scatterplots suggested a lack of homoscedasticity of variance. There was a cone-shaped pattern on the scatterplots instead of the expected rectangular pattern. This is indicative of a slight reduction of power and therefore a limitation of the study. However, the number of participants provided a large sample and power was obtained from this large sample size.

The use of 24-hour dietary recalls are subject to recall bias and memory reliance which may lead to inaccurate dietary intake information (Willett, 1998). Previous studies have used one 24-hour dietary recall to assess usual breakfast consumption. This study included three 24-hour dietary recalls (two weekdays and one weekend day) that may capture typical breakfast eating habits better than using only one 24-hour dietary recall.

In this study, most children were eligible for the National School Breakfast Program and may have received their breakfast meal through the school cafeteria (Trevino et al., 2008). The School Breakfast Program follows USDA guidelines providing calcium, iron, vitamin A, and vitamin C that are required nutrient standards for school breakfast meals (School Nutrition Association, 2008). Children who participated in the School Breakfast Program had significantly lower BMI, particularly among non-Hispanic White students (Gleason & Dodd, 2009).

This study included a predominately Hispanic sample of children from a lower socioeconomic status based on their residence within the SAISD. This is the second largest school district in south Texas with 89% of the student population coming from low-income homes (Trevino et. al., 2008). This is not a nationally representative sample; however, this study does address the growing Hispanic population in Texas.

Conclusions

The present study did not find an association between breakfast consumption and BMI. There are several methodological differences from previous studies that did find an association between breakfast and BMI that may have influenced the outcome. This is an important finding because it may be that eating breakfast does not influence BMI, unless the breakfast consists of nutrient-rich foods. Therefore, it may be more important to know the content of the breakfast especially among economically disadvantaged Hispanic children.

This present study added to the growing body of evidence that the frequency of RTEC consumption predicted a lower BMI. This present study is unique because it included a predominately Hispanic sample of children from low-income households. Hispanic children are at a greater risk of being overweight, especially in Texas, and developing type 2 diabetes than non-Hispanic children (Butte, Cai, Cole, & Comuzzie, 2006; Pontiroli, 2004; Cruz & Goran, 2004; Strauss & Pollack, 2001). Socioeconomic status may also play a role in the likelihood of a child being overweight (Mei et al., 1998; Lutfiyya, Garcia, Dankwa, Young, & Lipsky, 2008). The potential causes of why Hispanic children are overweight are a combination of biological, economic, and social factors such as poor nutrition. The family dinner table may be one contributor and also an avenue for behavioral change (Strauss & Pollack, 2001). The promotion of a well-balanced breakfast that includes RTEC may be a way to influence BMI and overall eating habits. There is a gap in the literature on breakfast and RTEC consumption among Hispanic children. This finding helps establish the foundation for future studies that investigate breakfast and RTEC eating patterns.

The finding that the consumption of RTEC improved the nutrient intakes of calcium, magnesium, vitamin A, vitamin C, and iron reinforces previous studies that found the same association (Albertson et al., 2003; Barton et al., 2005; Kafatos et al., 2005; Nicklas, O'Neil, & Myers, 2004; Song et al., 2006). Consistent RTEC eating may be an indicator of consistent nutrient-rich food consumption and possibly an overall well-balanced lifestyle (Barton et. al., 2005; Rampersaud, Pereira, Girard, Adams, & Metzl, 2005). The 2005 Dietary Guidelines for Americans identified the "food groups to encourage" to help Americans meet nutrient recommendations and help decrease the risk of chronic disease. The promotion of a nutrient-rich breakfast that includes the "food groups to encourage" such as whole grains from RTEC, low-fat and fat-free milk or milk products and fruits may help increase intakes of key nutrients (Rampersaud, 2009). This finding is particularly important for American children in general and among this sample of predominantly Hispanic children. Overall, American children are not meeting daily requirements of calcium and magnesium based on the USDA identifying these micronutrients as "nutrients of concern." Ethnicity, specifically Hispanic children, and a low-socioecomonic status place children at an increased risk of deficiency of iron, vitamin A, and vitamin C (Brotanek, Gosz, Weitzman, & Flores, 2007; Villalpando et al., 2003). Therefore, the promotion of RTEC for breakfast may be a low-cost method of helping to facilitate the consumption of key nutrients, such as calcium, magnesium, iron, vitamin A, and vitamin C, in American children (Nicklas et al., 2002).

In light of the health risks for overweight and obese children, measures should be taken to educate families and children about empowering them to make well-balanced decisions. Hispanic children are at an even greater risk for overweight and type 2 diabetes; therefore, nutrition education efforts should also focus on behaviors, such as eating a nutrient-rich breakfast, that help promote a healthy weight and overall well-balanced nutrient intakes among Hispanic children. Economical nutrient-rich breakfast foods that are convenient may be more easily incorporated into busy lifestyles. The routine consumption of RTEC may be one component of a healthful diet that aids in maintaining a healthy body weight and adequate nutrient intakes (Barton et al., 2005). RTEC consumed as a snack at other times during the day besides breakfast may increase intakes of essential nutrients lacking in children's diets. Since 92% of RTEC are fortified with essential micronutrients, it is a convenient, nutritious breakfast option for children (Cotton, Subar, Friday, & Cook, 2004).

Health professionals, especially those involved with nutrition education, should continue to promote the importance of eating a nourishing breakfast with RTEC as a nutritious option in lieu of other less nutrient-rich foods. Parents are powerful role-models for their children, ideally. Parents who understand this role may set an example for their children by eating a nutritious breakfast daily. RTEC is a convenient choice for breakfast due to its readiness for consumption. Schools may be a suitable setting for interventions aimed at developing positive eating behaviors such as consuming a nutrient-rich breakfast that includes whole-grain cereals, low-fat milk, and fresh fruit as part of the School Breakfast Program (Gleason & Dodd, 2009; Timlin, Pereira, Story, & Neumark-Sztainer, 2008).

Future research should investigate the following: the long-term effects of a healthy breakfast promoting interventions that evaluate causal links between nutrient-rich breakfast consumption and the risk for obesity and other chronic diseases; the influence of parental role-modeling on Hispanic children's breakfast consumption; the impact of location (home or school) on breakfast composition and nutrient intakes and the association with BMI; and the role of refined versus non-refined RTEC on nutrient intakes and BMI in children. The impact of the intake of RTEC consumption outside of the breakfast meal should be explored as well as other nutrient-rich snacks such as yogurt parfaits or fortified cereal bars. Ideally, implementation of a behavior intervention program designed to increase breakfast consumption and educate young elementary-age children and their parents about the importance of a nutrient-rich breakfast that includes RTEC, that continues through the 6^{th}-grade may offer more insight. Then compare the children that received the breakfast education to children that did not and determine if there is any correlation between regular RTEC consumption and BMI.

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