THE RELATIONSHIP BETWEEN EATING OCCASIONS AND BMI PERCENTILE IN SCHOOL CHILDREN

by

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Abstract

The relationship between meal frequency and BMI percentile in school-children

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Purpose: To identify the relationship between meal frequency and BMI in children. Methods: This was a cross-sectional study involving 1,004 children in grades 3-5 (age 7-12 y) from 12 elementary schools within the Kansas City, KS Public School District. Each child completed one testing day of height and weight measurements to determine BMI percentiles (BMI%). Number of eating occasions per day (EO), and total energy intake (EI) were identified using a multiple pass 24-hr diet recall administered by trained nutrition staff. Correlation analyses were performed to determine relationships between BMI%, EO, and EI. BMI% was also examined according to EO categorized as >3, 3 - 4, and ≥5 using ANOVA. Regression analysis was used to determine the best predictors of BMI%. Results: BMI% was 73 ± 27% ; EO was 4 ± 1 (range: 1-8); EI was 1,674± 784 kcals (range: 104-7,273). A lower BMI% was associated with a greater number of EO($r= -0.089$; $p<0.01$). A greater number of EO was also associated with a higher EI($r= 0.543$; $p<0.001$). Main effects of categorized EO were observed for BMI% ($p<0.05$). Children that had >3 EO had higher BMI% (80± 23%) compared to those who had 3-4 (73± 27; $p< 0.01$), and those who had >5 (72± 28; $p< 0.01$). The best fit model for predicting BMI% included EI, gender, and race/ethnicity ($R^2= 0.27$). A higher BMI% was predicted by a lower EI ($\beta= -0.102$; $p<0.001$), being male ($\beta= -0.093$; $p<0.01$), and by being white Hispanic ($\beta= 0.079$; $p<0.05$). Conclusion: Increased EO in combination with increased EI is associated with a lower BMI% in children. Gender and race/ethnicity also play a role in BMI%. The relationship between BMI% and EI may be a result of underreporting, but it is unknown whether this

translates to EO. The strong correlation between EI and EO may be masking the influence of EO on BMI%. The results suggest that increasing EO may be a beneficial strategy in combating obesity.

Acknowledgements

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List of In-Text Tables

List of In-Text Figures

Table of Contents

The Relationship between Eating Occasions and BMI Percentile in School Children

CHAPTER 1

Introduction

The obesity epidemic in the United States is a health occurrence which is of great concern in both adults and children. The percentage of overweight among children has increased in the U.S. from about 4% in the mid 1960's to almost 19% in 2004.[1,2] Recent studies have shown that this increasing trend was no longer seen from 2004 through 2006 [3] suggesting that the prevalence of overweight among children may be leveling off. However, we are far from the goal of 5% established by the Healthy People 2010 Initiative.[4] Overweight and obesity in childhood has been observed to not only predict overweight and obesity in adulthood[5-7], but is also a risk factor for many other dangerous health conditions such as heart disease.[7-11] Although there is poor evidence of successful weight loss treatments in general[12], attempts are needed to address both causes and treatments for obesity in children.

Meal frequency is one dietary pattern that has been perceived to have an association with body mass index (BMI). However, studies of various designs investigating the relationship between meal frequency and BMI have uncovered mixed results. Some studies have found that an increased meal frequency is related to a lower BMI[13-22] and therefore advantageous effect on body weight. In contrast, Howarth and colleagues reported the opposite; that an increased meal frequency is

associated with a higher body weight[23], while several other studies have found that no relationship exists between meal frequency and BMI.[24-29]

Definition of Terms

Body Mass Index (BMI) is a commonly used measure of adiposity. Universally, in both male and female adults, a BMI of 25kg/m^2 and above is defined as overweight while a BMI of at or above 30kg/m^2 is considered obese.[2, 30] Similarly, the Center for Disease Control (CDC) and the American Academy of Pediatrics recommend the use of BMI as a measurement tool in order to screen for overweight and obesity in children as early as 2 years of age.[2] However, when looking at body composition in children, there is no standard definition of adiposity in which specific BMI levels could be assigned.[3] In children body fat composition changes with age and also differs between boys and girls.[2] Therefore, these must be taken into consideration when assigning weight status in children. The 2000 CDC growth charts take into consideration both age and sex, and are the standard for use in determining weight status of children in the U.S.[3] (refer to Appendix A). In children, BMI is calculated identical to adults (body weight/height^2), except growth charts are then used to compare the calculations with a reference population and provide a percentile ranking.[2] The terms for increased BMI in children were previously regarded as: at risk for overweight and overweight.[31] As a means to further stress the seriousness of these conditions, the CDC now recommends using the terms overweight and obese to characterize high BMI status in children.

Currently, the term underweight is used to describe children with BMI percentile less than the 5th percentile, normal weight for those in the 5th to less than the 85th percentile, overweight for a child whose BMI is at or above the 85th percentile, and obese is used to describe those children with BMIs at or above the 95th percentile.[2, 3] Some of the latest studies focusing on the prevalence of overweight and obesity in children have included a further cut-off of at or above the 97th percentile in order to represent even the heaviest children.[3] However, there is one limitation in using the CDC growth charts for determining BMI percentiles in those children who are extremely overweight. The CDC growth charts do not go above the 99th percentile, thus any child whose weight for height is above this cutoff, are by default classified as being in the 99th percentile, when they may actually be well above this category. Barlow, et. al. (2007) addressed this weakness and designated raw BMI cut points according to age and gender for identifying children that are truly above the 99th percentile.[38]

Most studies consider a "meal" to be breakfast, lunch, or dinner, while "snacks" are considered all other eating episodes aside from main meals.[19, 29] In general, previous studies have obtained data on meal frequency in two ways. For observational studies, data on eating patterns is either determined by collecting a complete dietary recall or food diary[14, 21, 23, 26, 28, 29, 32]or by asking about typical eating occasions per day by means of a questionnaire.[18-20, 24, 25] Some investigators separate meals and snacks consumed depending on reports of occasion by the subject or by researchers coding responses after open-ended data has been collected. Studies in

meal frequency are vulnerable to errors due to these post hoc alterations in coding meal occasions.[33] The results of some studies may have been skewed because of these post hoc coding errors. For example, Howarth, et. al. (2007) and Huang, et. al. (2004) use the same techniques when coding for meal occasions. For both studies, eating occasions were self reported by the subjects and standardized by research staff after the fact.[23, 26] Meals were combined if they occurred within 59 minutes of each other and were called by the same occasion name.[23, 26] If eating occasions were combined this could cause the eating frequency for that subject to be lower, even though the two occasions could have been considered separate. Occasions with the largest energy contents were coded for as meals and the others as snacks. [23, 26] The researchers standardized meal occasions so that only one of each breakfast, lunch, and dinner could be included in the same day (allowing any number of snacks per day). [23, 26] Eating occasion was asked as an open ended question but was later recorded as categorical variables. Researchers considered midmorning "brunch" to be breakfast if it occurred before 11:00am and lunch if it occurred after 11:00am but before 2:00pm.[23, 26] Similarly, supper was considered to be lunch or dinner depending on time and energy content. [23, 26] The use of the codes breakfast, lunch, and dinner, as well as only allowing one per day are somewhat arbitrary and may have led to biased results, especially when data was stratified by eating occasion. Meal frequency studies are hard to quantify because individuals, both researchers and subjects, define snacks and meals differently.[34] For the sake of this study, meal frequency was defined as the total number of eating occasions in one day.

Statement of Purpose

Due to the variations in previous finding and the advantages of identifying the causes and possible treatments of overweight and obesity among children, further investigation into the interactions between eating occasions and BMI in children is needed. The purpose of this study was to evaluate the impact of all eating occasions in one day (not differentiating between snacks and meal types) on body weight status in children. This was a cross-sectional analysis of the relationship between BMI and meal frequency in a group of multi-ethnic, elementary school aged children in Kansas City, Kansas.

Research Questions

1. Is the number of eating occasions related to BMI in multi-ethnic, elementary school aged children?

2. Do gender and/or race and ethnicity also play a role in the eating occasion and BMI relationship in school-children?

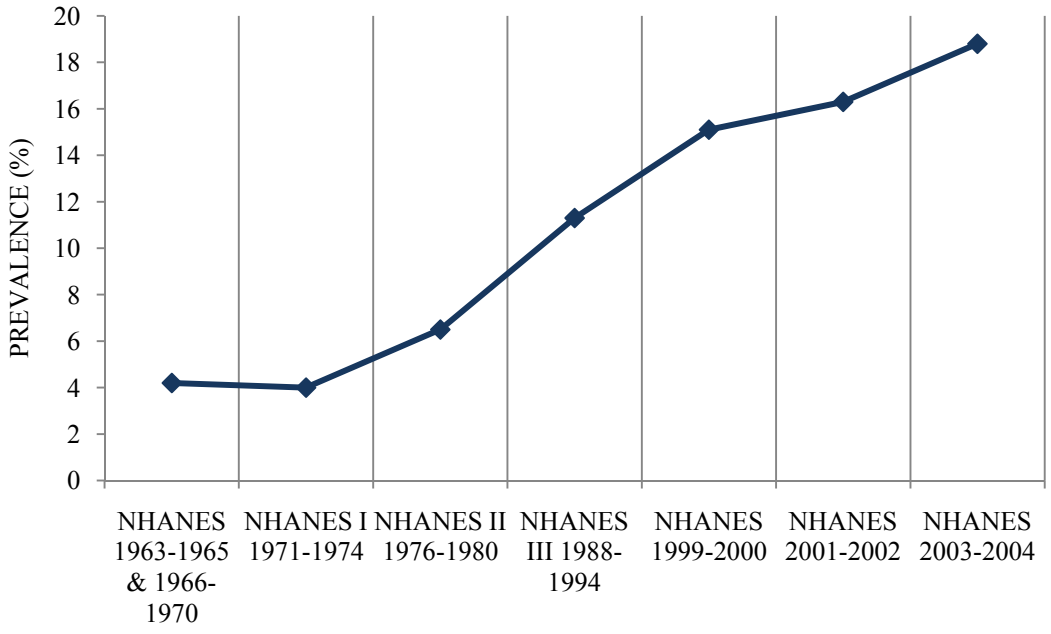
CHAPTER 2

Review of Literature:

Obesity Trends

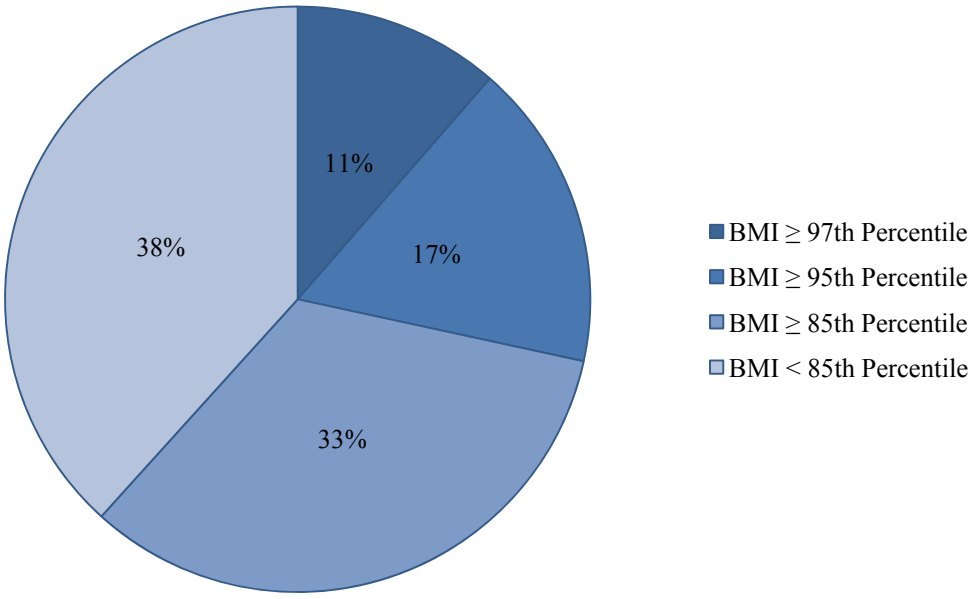
The prevalence of overweight and obesity in both adults and children alike have been steadily increasing throughout the westernized world.[5] The implications of these conditions on other health factors have become a topic of great concern. In the United States, obesity rates are so high it has become known as the obesity epidemic.[35] The prevalence of overweight and obesity in children living in the United States has been shown to have increased steadily from the mid 1960's until about 2004.[1, 2, 31] In the mid 1960's to the early 1970's, about 4% of grade-school children were considered overweight.[1, 2] This number progressively increased to almost 19% by 2004[2] (Figure 1). More recent data has found that although prevalence rates are still high, this increasing trend may be leveling off. The NHANES data from 2005-2006 found that there has been no significant change in the prevalence of high BMI for age in children since 2003-2004.[3] For these years it was estimated that 33.3% of children of all ages (2-19 years) were overweight, 17.0% were obese, and further 11.4% were found to have a BMI that was at or above the 97th percentile.[3] More specifically, grade-school children (ages 6-11 years) showed prevalence rates of 31.9% overweight, 16.3% obese, and 11.3% at or above the 97th percentile[3](Figure 2).

Figure 1: Increases in Prevalence of Overweight among U.S. Children Ages 6-11y



Adapted from [2]

Figure 2: Prevalence of High BMI for Age among Children Ages 6-11y, 2003-2006



Adapted from [2]

Although the prevalence rates have been shown to no longer be increasing, the obesity epidemic is still a widespread public health crisis in the United States. The Healthy People 2010 Initiative recognizes overweight and obesity as one of its ten leading health indicators, and identified the need for a reduction in the prevalence of children who were overweight or obese to five percent by 2010.[4] Despite having potentially halted the rise in high BMI prevalence rates in children, further efforts are needed to turn the epidemic around.

The Relationship of Childhood and Adult BMI

Many studies have been conducted that investigate the relationship between childhood and adult BMI. A prospective study, which followed 363 overweight and obese children from Southern Italy, found that a significantly high proportion of these children were overweight in adulthood.[5] Another prospective study done in the U.S. followed a random sample of 854 children into young adulthood (21-29 years of age).[6] These researchers found that, in general, children who had been classified as overweight or obese at a younger age (less than or equal to three years) and did not have obese parents, had a low relative risk for becoming overweight in young adulthood.[6] However, as the age at which children were determined to be overweight or obese increased, childhood obesity was seen to more accurately predict obesity in adulthood, regardless of whether or not they had an obese parent.[6] The Newcastle Thousand Families Study followed subjects from birth to the age of 50.[7] Data on BMI were available for ages 9, 13, and 50 years.[7] These researchers found that, in general, BMI increased through puberty and into adulthood, and by the age of 50 years nearly

60% of the men, and 41% or the women were overweight (with a BMI of >24).[7] They found that BMI in childhood of all subjects showed only a modest correlation with adult BMI.[7] However, when specifically considering subjects who had significantly high or low BMI status as children, a more pronounced relationship was seen. Those who had BMIs above the 95th percentile as children were five to nine times more likely to be obese (BMI>30) at the age of 50.[7] Conversely, children who had BMIs lower than the 25th percentile were equally as likely to have a high or low BMI at the age of 50.[7] Further, most of the subjects who were considered to be in the top 25% for body fat as an adult, had not been overweight as children.[7] In general these researchers concluded that although being overweight as a child did increase your risk of being overweight as an adult, most of the adults who were found to be overweight at the age of 50 were not necessarily overweight as children.[7] Additionally, children who were of normal or low BMI were not protected against overweight or obesity in adulthood.[7]

Health Effects of Obesity

Not only is being overweight in adulthood associated with an increased morbidity and mortality,[9] studies have also found that being overweight in childhood is related to an individual's future health status in adulthood.[7-11] The Newcastle Thousand Families Study previously discussed also included data on the effects of childhood obesity on other health markers. In addition to information on adult BMI, follow-up data at age 50 years were available on carotid artery thickness, blood pressure, plasma fibrinogen, total/LDL/HDL cholesterol, serum triglyceride levels,

fasting serum insulin, and two hour plasma glucose concentrations.[7] Higher triglyceride and cholesterol levels in adult women were found to be significant risk factors associated with childhood BMI.[7] A large prospective study carried out in England and Scotland which followed subjects for 57 years focused on mortality and cause of death.[8] The results of this study found that in both males and females, childhood BMI was positively associated with deaths from ischemic heart disease.[8] Specifically, children who had BMIs above the 75th percentile had twice the risk of death from ischemic heart disease compared to those with normal BMI.[8] Another study, which collected baseline data from 1922-1935 on lean and overweight adolescents, followed 508 subjects until 1988 and focused on health status and cause of death.[9] These researchers found that being overweight in adolescence was associated with increased risk of morbidity related to coronary artery disease and atherosclerosis in both males and females, increased risk of colorectal cancer and gout in males, increased risk of arthritis in females, and increased risk of all cause and disease specific mortality in males.[9] They additionally determined that being overweight in adolescence was a more powerful predictor of these risks than was adult BMI.[9]

The negative effects of obesity have not only been related to other health outcomes in adulthood, but also to social and economic outcomes in adulthood. Gortmaker and colleges followed 370 subjects from 1981 into early adulthood and found that women who were overweight as adolescence had completed fewer years of school, had lower household incomes, and had higher household poverty rates, while

both men and women who were overweight as adolescents were less likely to be married.[10] These outcomes were all significant even after controlling for other baseline measures such as competence test scoring and household income.[10] These associations were not seen to be present with any other chronic diseases within the same population.[10]

In addition to being a predictor of adult health and social consequences, having a high BMI in youth has also been coupled with deleterious outcomes while in childhood. As in adulthood, obesity co-morbidities in children include type 2 diabetes mellitus, metabolic syndrome, nonalcoholic fatty liver disease, and polycystic ovarian syndrome in females.[11] In addition to health effects, obesity has also been linked to social and educational issues in children. A large observational study of 5th graders looking at BMI, standardized test results, and self reported self esteem found that obesity was a risk factor for low self esteem, and although obesity did not directly predict school performance, high self esteem was a predictor of school performance.[36]

Causes and Treatment of Obesity

In order to decrease the prevalence of overweight and obese in the U.S. the causes behind these weight conditions must be understood. A person becomes overweight, and further obese, due to a continuous state of positive energy balance. That is, more energy being consumed than is being used by the individual.[35] The obesity epidemic is the product of this continuous state of energy balance in the population as a whole.[35] Energy balance depends on biological, behavioral, and

environmental factors.[35] More specifically many behavioral and environmental factors such as the ample availability and consumption of high energy dense foods, decreased energy expenditure due to common daily activities (television . watching, use of an automobile as a means of transportation, etc.)[37], increased consumption of sugar sweetened beverages[28], and increases in the proportion of calories consumed as snacks[24, 26, 28,29] have been linked to positive energy balance and overweight in children. Generally, having a high BMI status in children has been linked to various factors.

Regardless of the causes of overweight and obesity, the health effects of these conditions are dangerous and may potentially have life threatening effects. In adults, obesity treatments include various approaches like diet changes in micro and macro nutrients, altering eating habits, increasing physical activity, as well as many other methods used alone or in combination. Researchers have found that few diet approaches are capable of producing a significant change in behavior resulting in weight loss and long term maintenance.[12] In general, the most successful techniques incorporate relatively small steps for weight loss and involve behaviors which individuals will find easy to comply with and maintain as a continued lifestyle change.[35] Few behavior and diet interventions have proved successful at achieving weight loss and maintenance in children. It has been identified that more specific diet approaches are needed to lower the risk of overweight in children.[11] Multiple studies on the prevention of increased overweight and childhood obesity have found that

involvement of primary schools and school based interventions have been effective.[5,37]

Meal Frequency and BMI

Meal frequency has been proposed to be associated to BMI, but studies in adults and children have produced mixed results (refer to Table 1and 2). In adults, some observational studies have found an increased eating frequency to be associated with lower BMIs[13, 14], while others have found eating more meals per day to be associated with a higher BMI.[23] A few cross-sectional studies in adults have also found that eating frequency is not associated with BMI.[24, 25] Intervention studies in adults have also produced mixed results. Some studies have shown that increasing eating occasions led to lower subsequent energy intake and could lead to weight loss over time,[16,17]while Westerterp-Plategna and colleagues reported associations of meal frequency with energy intake but not with BMI.[15] Studies in children have produced similar mixed results. Some observational and intervention studies have found that a higher eating frequency is related to a lower BMI,[18-22] while others have shown no significant associations.[26-29]

Table 1: Summary of Meal Frequency Studies in Adults

Reference	Additional Characteristics	Design	Findings
Forslund HB, et. al., 2005	Obese & normal weight males & females	Cross-sectional Observation	Eating frequency was not related to BMI
Ovaskainen M-L, et. al., 2006	Random sample males & females	Cross-sectional Observation	Eating frequency was not related to BMI
Ruidavets JB, et. al., 2002	Males	Cross-sectional Observation	Low BMI was associated with increased number of eating occasions
Drummond SE, et. al., 1998	Normal weight males & females	Cross-sectional Observation	Increased eating frequency was associated with lower BMI in males, but no relationship in females
Howarth NC, et. al., 2007	Random sample males & females	Cross-sectional Observation	Eating ≥ 3x/day was associated with increased body weight
Westerterp-Plantenga MS, et. al., 2002	Healthy normal weight young men	Intervention	Men with a higher habitual meal frequency showed more acute energy regulation
Speechly DP, Buffenstein R., 1999	Lean males	Intervention	An isocaloric meal split into 5 occasions led to lower subsequent energy intake
Speechly DP, et. al., 1999	Obese Males	Intervention	An isocaloric meal split into 5 occasions led to lower subsequent energy intake

Table 2: Summary of Meal Frequency Studies in Children

Reference	Additional Characteristics	Design	Findings
Huang T T-K, et. al., 2004	Random sample boys & girls	Cross-sectional Observation	Eating frequency was not related to BMI percentile
Summerball CD, et. al., 1996	Adolescent boys & girls	Cross-sectional Observation	Feeding patterns did not predict BMI percentile
Nicklas TA, et. al., 2003	10 yr old boys & girls	Longitudinal Observation	Eating frequency was not related to BMI percentile
Lioret S, et. al., 2008	Random sample boys & girls	Cross-sectional Observation	No difference in eating frequency was seen between overweight and non-overweight subjects
Barba G, et. al., 2006	Random sample boys & girls	Cross-sectional Observation	Increased meal frequency was associated with lower BMI percentile and lower fat mass
Mota J, et. al., 2008	Adolescent boys & girls	Cross-sectional Observation	Increased meal frequency was associated with lower BMI percentile
Toschke AM, et. al., 2005	5-6 yr old boys & girls	Cross-sectional Observation	Prevalence of overweight and obese decreased as number of meals/day increased
Franco DL, et. al., 2008	Girls 9-19yrs old	Longitudinal Observation	Eating ≥3 meals on more days was associated with lower BMI z-scores
Fabry P, et. al., 1966	Boys and girls attending boarding school	Intervention	Subjects who attended the school which consumed 3meals/day showed larger increases in body weight compared to 5&7 meals/day

One cross-sectional study which included adult males from France, found that weight to height ratios, as well as BMI decreased significantly as the number of eating occasions increased.[13] Particularly, men who ate greater than or equal to five times per day were, on average, leaner compared to those men who were consuming less than or equal to two meals per day.[13] Drummond and colleagues used data from seven day food records from both male and female adults in the United Kingdom to determine if eating patterns had any relationship to BMI.[14] These researchers found a high eating frequency was associated with a lower BMI in males, but not in females.[14] They also reported that although eating frequency did not predict BMI in females, a higher eating frequency was related to a higher energy intake.[14] In males, however, an increased eating frequency was not correlated to a higher energy intake and may suggest that adult males, who increase eating frequency, are able to continue to consume an isocaloric diet by distributing the total energy consumed across their feeding episodes.[14]

Another relatively large cross-sectional study used the data of 2,685 individuals living in the United States who had completed the Continuing Survey of Food Intake of Individuals (CSFII).[23] This survey used data from two non-consecutive twenty-four hour diet recalls and self reported height and weight to determine whether or not a relationship exists between BMI and eating patterns.[23] In contrast to the previously discussed observational studies, the results of this survey found eating frequency in all ages was positively associated with energy intake and

eating more than three times a day was further associated with being overweight or obese. [23]

Another cross-sectional study of 5,351 individuals from Sweden used a meal pattern questionnaire to verify habitual intake occasions per day.[24] In this study, no relationship was seen between total eating occasions and body composition. [24] Similarly, a recent cross-sectional study conducted in Finland, which also used a questionnaire to detect eating habits along with a subsample of a forty-eight hour diet recalls, found that meal frequency was not a predictor for BMI.[25]

Researchers in South Africa who wished to examine the relationship between BMI and meal patterns conducted two different intervention studies.[16, 17] In both studies *ad libitum* intake of a subsequent meal was compared between subjects who first consumed a control meal at one occasion and subjects who ate the same meal split up into five separate occasions given hourly. [16, 17] One study included 88 healthy, normal weight, young males and found that the subjects who ate the meal as one occasion consumed significantly more calories at the succeeding *ad libitum* meal compared to those subjects who had consumed the initial meal spread out over five separate occasions.[16] The second study by these investigators focused on the same intervention in seven obese men.[17] Results for these subjects were comparable to the results for the normal weight males; the obese men in the single meal group consumed higher calories at the *ad libitum* meal than did the obese males receiving the initial meal as five separate occasions.[17] Both intervention studies therefore suggest that an isocaloric diet spread out among more feeding occasions leads to

lower subsequent energy intake and if continued over time could lead to weight loss and lower BMI in both normal and obese males.

Westerterp-Plantegna and colleges from the Netherlands compared the differences between habitual and manipulated meal frequency and their relationships with overall energy intake in 20 normal weight males.[15] They reported that the subjects' habitual, or normal, meal frequency was more significantly related to energy intake than an experimentally manipulated meal frequency.[15] The men with a higher habitual meal frequency had lower overall energy intakes, and also showed less variation in energy intake when meal frequency was experimentally manipulated.[15] These results suggest that men who eat more frequently on a normal basis have more accurate energy intake regulation and may therefore have more success at maintaining healthy weight.

In a cross-sectional study including a large sample size of children from Southern Italy, parents were asked about their child's usual meal intake in one day.[18] Results from this study showed that eating frequency was inversely associated with fat mass and abdominal fat deposition in these children.[18] Thus, children who typically ate more meals in one day were found to be leaner than children eating a lower number of meals per day.

A recent cross-sectional study of 886 Portuguese adolescents assessed meal frequency by asking subjects how many meals per day they consumed.[19] Possible answers included: one, two, three, four, five, or six. [19] The findings presented from this study illustrated an inverse relationship between meal frequency and BMI.[19] A

larger observational study of five to six year old German children used similar techniques to determine meal frequency except the parents were asked to report the number of meals their child consumed per day from the list of possible responses.[20] This analysis showed that as the number of meals per day increased, the prevalence of overweight and obese children decreased, suggesting that more frequent eating occasions may be protective against the development of overweight and obesity in young children. [20] A longitudinal study involving girls ages nine through nineteen years collected three day food diaries and anthropometric data annually for ten years. [20] Girls who more frequently ate greater than or equal to three meals had lower BMI for age z-scores compared to girls consuming less than three meals on most days.[21] These researchers concluded that meal frequency was related to BMI and suggested that meal frequency should be considered when developing guidelines for the prevention of overweight and obesity in children. [21]

The data from the CSFII discussed previously to assess the relationship between meal frequency and BMI in adults was also used to inspect this relationship in children.[26] Data from 537children who were between the ages of six and eleven years and revealed that total eating frequency was not related to BMI. [26] Similarly, a cross-sectional study of 220 British adolescents revealed that BMI was not associated with meal frequency, and the authors of this study even went on to suggest that feeding patterns are not a major factor in determining BMI in humans.[27] Another cross-sectional study used data from the French National Food Consumption Survey to examine the connection between BMI and meal frequency. The data collected from

this survey consisted of seven day food records along with self reported height and weight values for children aged three to eleven years.[29] It was determined that eating frequency was not significantly different between overweight and non-overweight subjects.[29] Analogous to the results from these cross-sectional observations, one longitudinal study conducted in the U. S., which followed 1,562 children over a twenty-one year period, also found no relationship between meal frequency and BMI.[28]

In contrast, an intervention study preformed in Prague in 1966 on 226 children and adolescents attending boarding school manipulated the meal frequency on a school wide level.[22] While the children at all of the schools as a whole were found to have similar energy intake amounts, the method of intervention split the meals into either three, five, or seven meals per day for one year.[22] In children six to ten years old, no difference in body composition was observed between the three different meal frequencies.[22] However, in the older children (ten to sixteen years), there was a greater increase in the index of proportionality (body weight increased more than height) in those that consumed three meals per day compared to those at the schools consuming five or seven meals,.[22] Fabry *et. al*. also found that these weight changes were more pronounced in girls.[22] Even as early as 1966, these researchers concluded that their findings deserve attention due to the rising incidence of obesity among children.[22]

Summary

The prevalence of overweight and obesity in children has been steadily increasing in the US and the implications of these conditions have become a topic of great concern[1-5]. Being overweight in childhood been linked to being overweight as an adult[5-7] which is associated with an increased morbidity and mortality.[9] Further, being overweight in childhood had also been independently associated with numerous health implications in adulthood[7-11] including increased blood pressure and cholesterol,[7] as well as increased risk of heart disease.[8] Having a high BMI has also been coupled to health and social consequences in childhood.[11, 36] There is a need to decrease the prevalence of overweight and obese in the US, however few diet approaches have been able to produce long term weight loss and maintenance.[12] In general, the most successful weight loss techniques include those which encompass relatively small changes which are simple for patients to understand and comply with.[35] Meal frequency has been proposed to be associated with BMI [13-22], and may prove to be an advantageous approach to weight loss in children. However, previous studies have produced mixed results.

CHAPTER 3

Methods

Overview

This was an auxiliary cross-sectional analysis of baseline data collected as a part of the KUMC KIDS study (University of Kansas Medical Center, Kansas Intervention with Dairy in Schools) under the direction of Dr. Debra Sullivan (NIH: R01 HL080967-01A2). The primary aim of the KUMC KIDS study is to determine the impact of dairy foods on blood pressure. The overall KUMC KIDS project is an ongoing intervention study which is comprised of multiple testing periods. The current study used only baseline data from year one of the KUMC KIDS study. The primary aim of this analysis was to determine if a relationship exists between meal frequency and BMI in a sample of elementary school children from Kansas City, Kansas.

Sample

The subjects were recruited from 12 elementary schools within the Kansas City, Kansas Public School District by informational packets sent home to parents. Written consent from parents as well as assent of the minor child was obtained for all participants (Appendix B). All subjects were included in the study if they were attending 3rd, 4th, or 5th grade in one of the 12 participating elementary schools, desired to take part in the study, and had properly returned consent forms signed by both parent and child.

Setting

Data were collected in August through October of 2007. Data collection was performed at each child's elementary school during school hours on a designated testing day. One testing day was completed at each of the individual schools. Children were called out of class in groups of 10-20 to complete all measurements in an area designated by that school's principal (usually a multipurpose room or cafeteria).

Ethics

This study was an auxiliary to the KUMC KIDS study which was approved by the Institutional Review Board of the University of Kansas Medical Center. In addition, the project was approved by the Executive Officer, Research Officer and individual principals at the Kansas City, Kansas School District.

Procedure and Materials

Research staff were trained and tested for accuracy and reliability prior to data collection. On testing day, age, sex, height, and weight were obtained. Race/ethnicity was also obtained by self report and checked against history forms filled out by parents included in consent packets. All data were recorded on each child's individual data sheet (Appendix C). Nutritional intake data were documented on a 24 hour recall form (Appendix D).

Assessment of BMI

Height was collected using a stadiometer accurate to 0.1cm. Height measurements were repeated so that 3 values were recorded for each subject. Weight

was collected by the use of a digital scale accurate to 0.1kg. Weight was also repeated so that 3 measurements were recorded. The average of the three measurements was then used to calculate BMI using the standardized equation (kg/m^2). BMI for age and gender percentiles were determined according to the 2000 CDC growth charts and cut points for the 99th percentile as previously described.[2]

Assessment of Dietary Intake

Dietary intake of individuals was obtained by completing a multiple pass 24-h diet recall administered by trained nutrition staff. In order to determine accurate portion sizes, interviewers provided visual models including three dimensional food replicas, measuring cups, common serving vessels, and a detailed reference booklet which contained photos of common foods in this population as well as menus for local restaurants. After data were collected in the school setting, diet recalls were entered into Nutritional Data System for Research (version 2006, University of Minnesota, Minneapolis, MN) by trained nutrition staff at our lab on the University of Kansas Medical Center campus. Dietary intake data for all subjects that had provided recalls and had BMI data were used for analysis. For the sake of this study, the total number of eating occasions per day was calculated for each subject, not including occasions in which water alone was consumed, were evaluated. Energy intake (kcals) and macronutrient intake (grams) per day were also determined.

Data and Statistical Analysis

All subjects were included in our analysis. BMI was calculated and converted to BMI for age percentiles as previously noted.[2] Outputs from Nutrition Data System

for Research (NDSR; version 2008; Nutrition Coordinating Center; University of Minnesota School of Public Health) were prepared to determine the number of eating occasions, total energy intake, and macronutrient totals per day. Statistical analysis was performed using SPSS (version 16.0 SPSS Inc.Chicago, Illinois). Population characteristics are represented as means plus or minus the standard deviation and frequencies. Prevalence rates of overweight and obesity within our sample population were examined to determine if this population is comparable to children in the overall U.S. population. Pearson Correlation analyses were performed to determine relationships between BMI percentiles, eating occasions, and total energy intake. Additionally, BMI percentile was examined according to eating occasions categorized as less than 3, 3 to 4, and 5 or more per day using one-way ANOVA with LSD post hoc analysis. One-way ANOVA was used to determine if differences in eating occasions and dietary intake exist between subjects when grouped according to BMI percentile status as underweight (less than the 5^{th}), normal weight (5^{th} to less than the 85^{th} percentile), overweight (greater than or equal to the 85^{th} percentile), obese (greater than or equal to the 95^{th} percentile), and above the 99^{th} percentile. ANOVA was also used to investigate if differences in BMI percentile and eating occasions existed between genders and race/ethnicity. To better determine the best predictors of BMI percentiles in children a stepwise multiple regression analysis was also preformed. The model included BMI percentile as the independent variable, and eating occasions (#/d), energy intake (kcal/d), gender, and race/ethnicity as dependent variables. A p-value of less than 0.05 was considered to be statistically significant.

CHAPTER 4

Results

This was a cross-sectional, observational study involving 1,004 children in grades 3-5 (ages 7-12years) from 12 elementary schools within the Kansas City, Kansas Public School District. The primary aim was to identify the relationship between meal frequency and BMI.

Subject Characteristics

Subject characteristics are listed in Table 3. This study included 1,004 children age 9± 1 y (range: 7-12 y). This group was 45.9% male and 54.1% female. Race/ethnicity breakdown is shown in Figure 3. This study included 50.7% white Hispanic, 25.1% black non-Hispanic, 13.1% white non-Hispanic, 7.4% bi/multi racial, and 3.7% other (including Asian, American Indian, and all other). Due to the small sample size comprised of bi/multi racial and other race/ethnicities, both of these groups were combined to make up 11.1% of the study cohort. The average height was 138 ± 9 cm, average weight was 39.6 ± 12.6 kg, and the average BMI percentile was 73 ± 27%. Body weight status is shown in Figure 4. Specifically, 1.6% of the subjects were underweight (<5th percentile), 50.6% normal weight (5th to > the 85th percentile), 17.2% overweight (≥ the 85th percentile), 23.4% obese (≥ the 95th percentile), and 7.2% were above the 99th percentile. Eating occasions ranged from 1 to 8 per day with a mean of 4± 1 occasions. As shown in Figure 5, when grouped according to the number of eating occasion/d, 10.4% of the children had < 3 eating occasions/d, 72.9% had 3 to 4 eating occasions/d, and 16.7% had > 5 eating

occasions/d. The average total energy intake was 1,674± 784 kcals/d. Average fat intake was 58± 34g/day, carbohydrate was 234± 111g/day, and protein was 61± 30g/day.

Table 3: Descriptive Statistics

Subject Characteristics	
Male (%)	46
Age (yrs)	9 (±1)
BMI Percentile	73 (±27)
Height (cm)	138 (±9)
Weight (kg)	40 (±13)
Eating Occasions (#/day)	4 (±1)
Energy Intake (kcal/day)	1674 (±784)
Fat Intake (g/day)	58 (±34)
Carbohydrate Intake (g/day)	234 (±111)
Protein Intake (g/day)	61 (±30)

Figure 3: Subject Race/Ethnicity

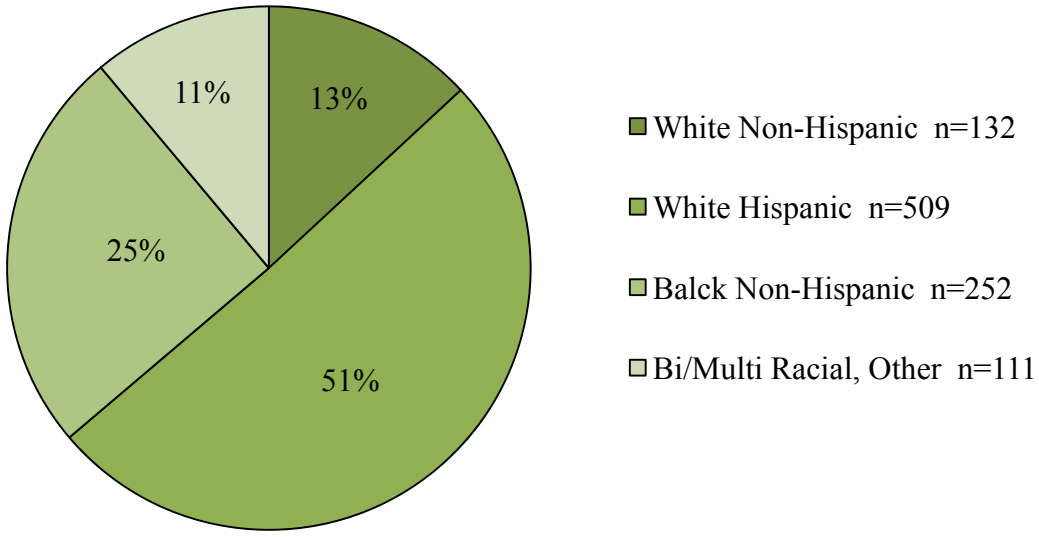


Figure 4: BMI Percentile Status

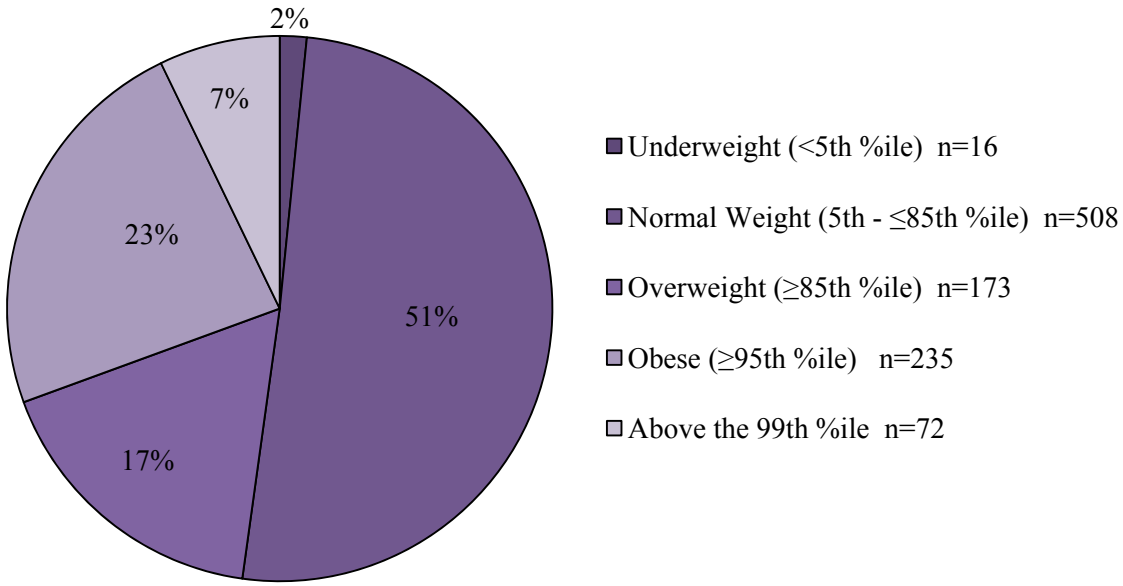
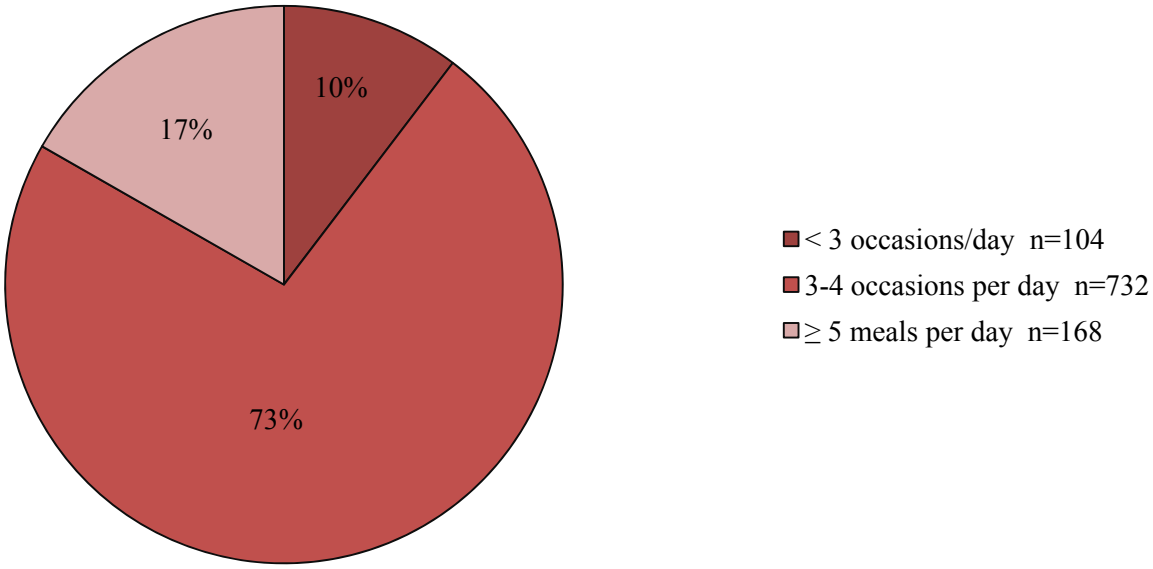


Figure 5: Groups According to Eating Occasions



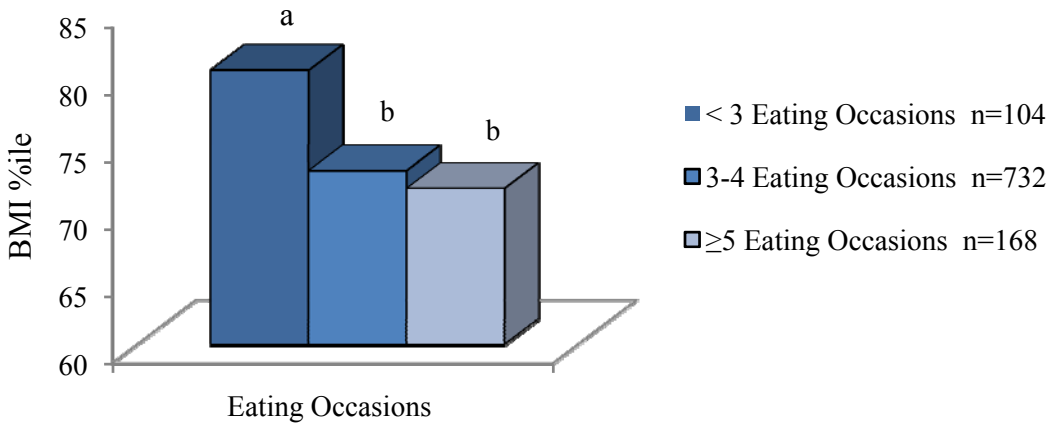
Association between BMI Percentile and Eating Occasions

Eating occasions were inversely associated with BMI percentile such that a greater number of eating occasions was associated with a lower BMI percentile ($r = -0.089$; $p<0.01$). Eating occasions were positively associated with overall energy intake ($r = 0.543$; $p<0.001$), fat intake ($r = 0.427$; $p<0.001$), carbohydrate intake ($r = 0.560$; $p<0.001$), and protein intake ($r = 0.426$; $p<0.001$). After controlling for energy intake, a partial correlation revealed that the relationship between BMI percentile and eating occasions was no longer significant ($r = -0.033$; $p=0.290$).

Main effects of Categorized Eating Occasions

When examining eating occasions as a categorized variable, a main effect of categorized eating occasions was observed for BMI percentile ($p<0.05$) (Figure 6). Children with <3 eating occasions/d had higher BMI percentiles (80± 23%) compared to those who had 3-4 eating occasions (73± 27; $p< 0.01$), and who had >5 (72± 28; $p< 0.01$). No difference in BMI percentile was seen between those children having 3-4 eating occasions/d vs. those having >5 eating occasions.

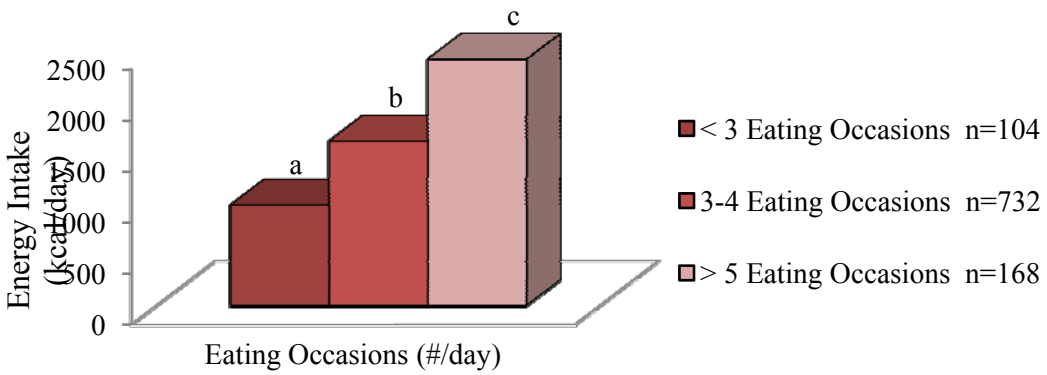
Figure 6: Main effects of Categorized Eating Occasions on BMI Percentile



[1way ANOVA: Different letters denote significant differences ($p<0.01$) between groups]

A main effect of eating occasions was also observed for daily energy intake ($p< 0.001$) (Figure 7). Children with <3 eating occasions/d had lower energy intakes (980± 532kcal/d; $p< 0.001$) compared to those with 3-4 eating occasions/d (1605± 614kcal/d; $p< 0.001$), and those with >5 eating occasions/d (2405± 1002kcal/d; $p< 0.001$). Children with 3-4 eating occasions/d also had significantly lower energy intakes compared to those with >5 eating occasions/d ($p< 0.001$).

Figure 7: Main effects of Categorized Eating Occasions on Energy Intake

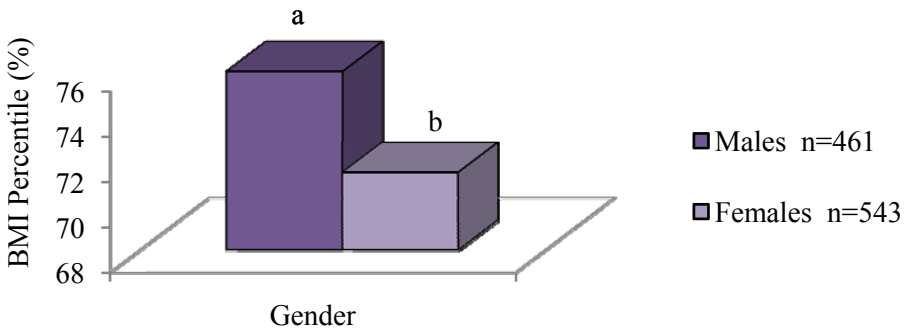


[1way ANOVA: Different letters denote significant differences ($p<0.001$) between groups]

Gender and Racial/Ethnic Differences

No difference in easting occasions/d or daily energy intake were observed between males and females. However, gender differences were observed for BMI percentile ($p< 0.01$) such that males had a higher BMI percentile (76± 25%) compared to females (71± 28%) (Figure 8).

Figure 8: Gender Differences

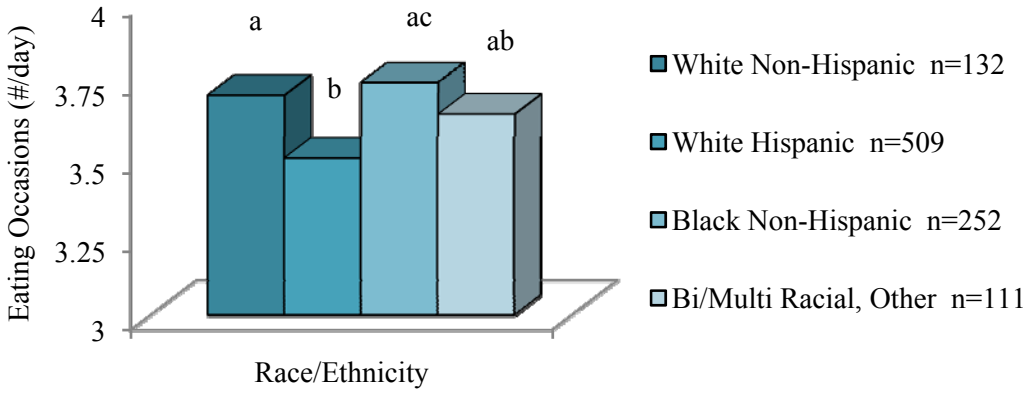


[1way ANOVA: Different letters denote significant differences ($p<0.01$) between groups]

Main effects of race/ethnicity were observed for eating occasions ($p< 0.05$), BMI percentile ($p< 0.01$), and daily energy intake ($p< 0.001$). Specifically, White

non-Hispanic and black non-Hispanic children had a greater number of eating occasions/d (3.7± 0.9) compared to white Hispanic children (3.5± 1.0 eating occasions/d; $p<0.05$; $p<0.01$, respectively) (Figure 9). No other differences in eating occasions were observed.

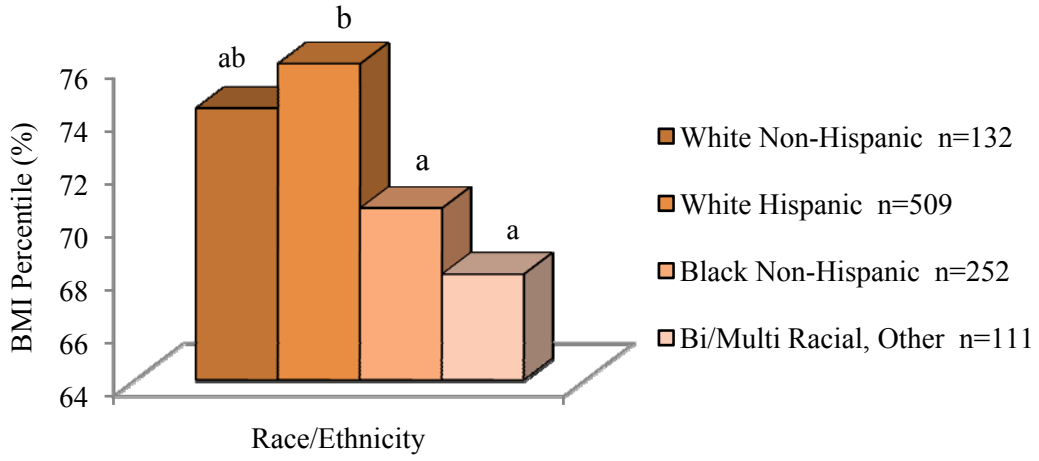
Figure 9: Racial/Ethnic Differences in Eating Occasions



[1way ANOVA: Different letters denote significant differences ($p<0.01$) between groups]

Differences between racial/ethnic groups were also observed with BMI percentile (Figure 10). White Hispanic children exhibited higher BMI percentiles (76± 26%) when compared to black non-Hispanic children (71± 27%; $p<0.01$) and bi/multi, other racial children (68± 28%; $p<0.01$).

Figure 10: Racial/Ethnic Differences in BMI Percentile



[1way ANOVA: Different letters denote significant differences ($p < 0.001$) between groups]

Predictors of BMI Percentile

The best fit model for predicting BMI percentile in our population included energy intake (kcals), gender, and race/ethnicity ($R^2 = 0.27$) (Table 4). Specifically, a higher BMI percentile is predictive of a lower energy intake ($\beta = -0.102$; $p<0.001$), being male ($\beta = -0.093$; $p<0.01$), and by being white Hispanic ($\beta = 0.079$; $p<0.05$).

Table 4: Best Fit Model for BMI Percentile Prediction

	b	SEb	β	P
Constant	79.894	2.502		
Energy Intake	-0.003	0.001	-0.102	<0.001
Gender (Female)	-5.008	1.677	-0.093	<0.01
White Hispanic	4.206	1.701	0.079	<0.05

Multiple regression analysis; $R^2=0.27$

CHAPTER 5

Discussion

Subject Characteristics

A high proportion of this population was of minority race/ethnicities. Half of the children included in this analysis were white Hispanic, while 25% were black non-Hispanic. In previous studies, high obesity rates were seen in predominantly minority populations.[3] Almost half of the children participating in our study were overweight or obese. However, the observed prevalence rate is lower than the general US population trend of 61% [2], and the average BMI percentile of the population can be classified as normal weight.

Expected eating patterns were seen in the number of eating occasions consumed per day. Most of the children consumed 3-4 meals per day which could be associated with the common meal patterns of breakfast, lunch, and dinner.

Association between BMI Percentile and Eating Occasions

Previous studies have produced various results on the relationship between eating occasions and BMI percentile in children. In the review of literature, there were more studies relating higher BMI percentiles to fewer feeding frequencies per day. Similar to these findings, the current data support that an increased number of eating occasions was associated with lower BMI percentile in school aged children. However, the partial correlation controlling for energy intake revealed no significance. This does not necessarily mean that eating occasions are not influencing BMI percentile. The strong relationship between energy intake and eating occasions

may be masking the influence of eating occasions on BMI percentile when both variables are included in analyses.

The inverse relationship between energy intake and BMI percentile in our population is not consistent with previous research. It is well know that an increase in energy intake is actually correlated to an increased body weight or BMI. In this sample, an increase in energy intake was closely correlated with an increase in eating occasions, which were both correlated with a lower BMI percentile.
This relationship may possibly be explained by under-reporting of energy intakes by overweight/obese subjects.

Both over and underreporting can lead to distorted nutritional data outcomes.[40-46] When considering the use of reliability questions in determining whether or not to include subjects as previously proposed, it was recognized that this method was itself inaccurate. These reliability questions were included at the end of each recall and consisted of a question for the child which addressed whether he or she considered the recalled intake to be a normal amount, and a question to be answered by interview staff which addressed the perceived reliability of the child interviewed.

It was initially proposed that a subject would be excluded if they had answered that their intake was an abnormal amount and/or the interviewer had concluded that the subject was unreliable for any reason. However, it was revealed that in using these guidelines, 501 subjects, almost 50% of the sample size would have been lost. Upon further investigation it was realized that the administration of

these questions was imprecise and misleading. For example, some interviewers were marking that the child had replied that the intake was abnormal but included no notes as to why it was an abnormal intake. Similarly, interviewers were also noting that a child was unreliable but gave no explanation as to why. Some subjects had answered that is was an abnormal intake because of the actual food eaten instead of the amounts of food. Because a case by case investigation into the reliability of these responses could have been biased, it was decided to not use this method as a means for deciding which subjects to exclude.

Determination of under and over reporting can also be based on evaluation of reported energy intake in relation to the subjects estimated energy needs. Estimated energy need (kcal/d) was calculated for each subject according to WHO/Schoffield equation for 3-10yr olds (M: REE=22.7W+ 495; F: REE=22.5W +499).[39] The modified Goldberg[40-41] was then applied to the 24-h diet recall for each subject to identify whether each recall was reliable. This approach requires that the ratio of energy intake to estimated energy need is greater than 1.30 for males and greater than 1.36 for females ages 7-12. When this method was applied, 636 of the subjects in this study were excluded. The 24-h recalls that at least met the subjects estimated energy needs totaled 389. Both approaches would exclude a significant proportion of the sample size. Further, if applied, both approaches would have excluded mostly overweight and obese subjects.

We chose to incorporate another approach which eliminated the 24-h diet recalls which were +/-2 standard deviations for the ratio of energy intake:REE. This

approach excluded zero subjects. This suggests that the intakes of the subjects from this population are not comparable to the populations used in determining these exclusion equations, but do have similar intake compared to one another. Along these lines, it is unknown whether subjects are misreporting the actual eating occasions or just the amount of food eaten within each occasion. Because the primary outcome variable of this study is eating occasions, it was decided that all subjects would be included in our analyses. Therefore, the analysis could include under/over reported energy intakes.

It is also possible that the subjects in our study are truly not meeting their energy needs. Previous research demonstrates similar findings. In a study of 1,402 mostly Hispanic fourth graders, Trevino, et al. (2008) discovered that 44% of their subjects had reported less than the minimum recommended energy intake. It is possible, especially in populations which are minority predominant, that children are consuming energy insufficient diets.

Main effects of Categorized Eating Occasions

Eating less than three eating occasions per day seems to have the most significant impact on increased BMI percentile, and a lower energy intake. The specific difference in consuming less than three meals per day was also observed by Fabry ***et. al***. who found a greater increase in the index of proportionality (body weight increased more than height) in those that consumed three meals per day compared to those at the schools consuming five or seven meals. [22]

Gender and Racial/Ethnic Differences

Gender and race/ethnicity also play a role in body composition in children. Significant interactions were seen between BMI percentile, gender, and race/ethnicity in previous research. Specifically, African-American and Hispanic girls are more likely to have high BMI for age than are non-Hispanic white girls.[3] In boys, Hispanics are more likely to have high BMI for age when compared to non-Hispanic white boys.[3] Similarly, our subjects were more likely to have higher BMI percentiles if they were males and were white Hispanic.

Predictors of BMI Percentile

Regression analyses of the current data indicate that the variability observed in BMI percentile was due primarily to energy intake, gender, and race/ethnicity. Many previous studies either controlled for energy intake[13], did not collect data on daily energy intake[18-20, 29], or found that energy intake was not a significant predictor of BMI, and was there for not included in regression models.[23] However, a review by Bellisle *et. al.* concluded that any differences in body composition as a result of meal patterns are likely to be due to energy balance.[33]

As seen in previous studies, the feeding frequency in this population was lower in children with increased BMI percentiles. These results could imply that meal patterns play a pronounced roll in the body composition, and could be used to further develop overweight and obesity interventions in school aged children. Since a higher meal frequency is related to lower BMI levels, increasing eating occasions among children might be an advisable approach for weight loss or maintenance. It

has been previously suggested that school based interventions are a potentially successful approach. [5, 37] One possible advantageous intervention may be to incorporate an afternoon snack, of good nutritional value, into a typical school day. Also, since meal frequency is found to be a predictor of BMI percentiles, recommendations for children to increase the number of times they eat in a typical day may be advisable. This recommendation would probably be understood more readily than other specific weight loss diet approaches. It may also be more successful compared to a strict weight loss diet because children could more effortlessly adhere to increasing the number of times they eat per day.[35]

Limitations and Future Research

For the sake of clarity and standardization, potential errors were avoided that may have occurred due to employing arbitrary post hoc coding terms for meals and snacks. Each separate event at which food or an energy containing beverage was consumed throughout the day was considered a separate feeding occasion with no further classification of meal type. This may have offered improvement on methods of previous research and could be used in future studies. Although coding for meals and snacks was not used, future studies could explore individual meal sizes. The current results showed that children with lower BMI percentiles were eating more times per day. By incorporating data on the relative sizes of meals, meal setting, and times, future studies may lend more insight into the eating patterns of children.
In previous studies the collection of dietary intake data has been conducted using various techniques. Food frequency questionnaires[18-20, 24], 3 day[13] or 7 day food

records[14], and 24 hour diet recalls[23] have all been used. Although 24 hour recalls are regarded as a valued method for collecting dietary intake data, they are still subject to error due to misreporting. Similar to findings in adult dietary recalls, a study by Fisher, et al. of 146 4-11 year old children found that under-reporting tended to occur most among overweight children. [42] Another study of 177 11 year old girls also found that under-reporters had higher BMI percentiles. [43] Specifically, 2/3 of their subjects who had reported implausible intakes were overweight or obese.[43]

In an attempt to conserve power in the current study, all subjects were included. As a result, subjects who under-reported their intakes were possibly included in this analysis. However, it is unknown whether the under-reporting of energy intake also translates to underreporting of the number of eating occasions reported. Future studies could explore this question.

The results of the current study were based on a dietary recall from one week day. Future studies may produce more reliable results if several recalls were collected and included weekday as well as weekend intakes. A high proportion of the children in the current study consumed breakfast, lunch, and some snacks while at school. Including a weekend could lend insight into whether the same patterns are followed when children are not at school.

Although the inverse relationship between energy intake and BMI percentile was unexpected, previous studies have also concluded that overweight and obese children consume significantly fewer calories compared to normal weight children. [44, 45] One of these researchers contributes the high BMI percentiles despite low caloric

intake to low levels of physical activity. However, this remains a large limitation of this study. Data pertaining to physical activity were not available at the time of analysis. It is well known that body composition is directly related to diet as well as physical activity.

Conclusion

This was a cross-sectional study which found that an increased number of eating occasions was related to a lower BMI percentile in school aged children. Thus, increasing meal frequency may be one factor to consider to reduce the obesity rates in children. Many factors including gender and race/ethnicity seem to also play a role in BMI percentile along with energy intake and eating occasions. Although appropriate measures were taken in order to attempt to increase the reliability of our results, the limitations and lack of physical activity data must be taken into consideration. Future studies are needed that address the mentioned limitations and that look further into the influence of eating patterns on body composition in children.

CHAPTER 6

Summary

Previous research in meal frequency and obesity in children has been unequivocal. The purpose of this study was to identify the relationship between meal frequency and BMI in school-children. This was a cross-sectional study involving 1,004 children ages 7-12 years old. Each child completed one testing day of height and weight measurements to determine BMI percentiles. Number of eating occasions per day, and total energy intake were identified using a multiple pass 24-hr diet recall administered by trained nutrition staff. Correlation analyses were performed to determine relationships between BMI percentile, eating occasions, and energy intake. BMI percentile was also examined according to eating occasions categorized as >3, 3 - 4, and ≥5 using one-way ANOVA. Regression analysis was used to determine the best predictors of BMI percentile. BMI percentile was 73 ± 27% , eating occasions per day were 4 ± 1, and energy intake was 1,674± 784 kcals. A lower BMI percentile was associated with a greater number of eating occasions($r= -0.089$; $p<0.01$). A greater number of eating occasions was also associated with a higher energy intake($r= 0.543$; $p<0.001$). Main effects of categorized eating occasions were observed for BMI percentile ($p<0.05$). Children that took >3 eating occasions had higher BMI percentile (80± 23%) compared to those who took 3-4 (73± 27; $p< 0.01$), and those who took >5 (72± 28; $p< 0.01$). The best fit model for predicting BMI percentile included energy intake, gender, and race/ethnicity ($R^2= 0.27$). A higher BMI percentile was predicted by a lower energy intake ($\beta= -0.102$; $p<0.001$), being male

(β= -0.093; $p<0.01$), and by being white Hispanic (β= 0.079; $p<0.05$). An increased number of eating occasions in combination with increased energy intake is linked to a lower BMI percentile in school-aged children. Gender and race/ethnicity also play a role in BMI percentile. The relationship between BMI percentile and energy intake may be a result of underreporting, but it is unknown whether this translates to eating occasions. The strong correlation between energy intake and eating occasions may be masking the influence of eating occasions on BMI percentile. The results suggest that increasing eating occasions may be a beneficial strategy in combating obesity in school-aged children.

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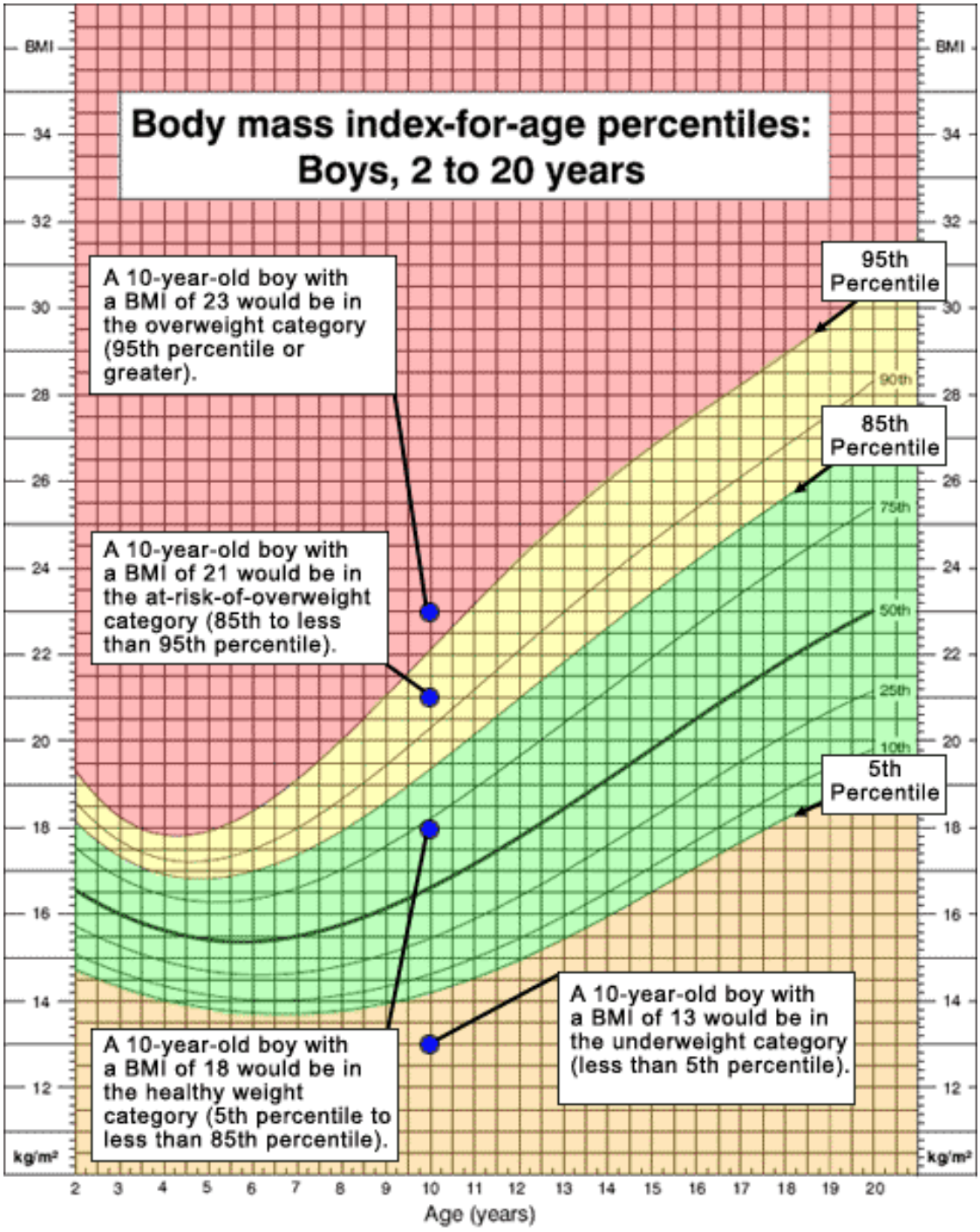
APPENDIX A:

CDC Growth Chart for boys



Centers for Disease Control: http://www.cdc.gov/

APPENDIX B:

KUMC KIDS consent form

University of Kansas Medical Center
Snack Nutrition Program

Dear Parents:

We are inviting all children in grades 3-5 to take part in a snack program at our school. If you decide to let your child participate, then your child may receive healthy snacks each school day if your school is chosen. Half of the schools participating in the program will receive the snacks and the other half of the schools will not receive the snacks. Dietitians from the University of Kansas Medical Center will direct the program.

The purpose of the program is to find out if eating 2 servings of dairy foods every school day will affect children's blood pressure and growth rate.

At the start of the school year, we will measure your child's height, weight, arm circumference, waist circumference, and blood pressure. To find out how active your child is, we will ask some questions about physical activity. We will also ask about the foods your child eats. After the testing is done, if your child is at the school that receives snacks, then he/she will be given healthy snacks each school day for the entire school year. At the middle and end of the year, we will do the same tests again.

If you want your child to be in the program, you must fill out the attached consent form. If you do not wish your child to be part of the program, simply sign the note below and return the form to the school. If you have any questions, we will be at your child's school during the back to school night or you may call us at (913) 588-5357.

We look forward to working with your child. We hope that everyone can participate.

Sincerely,

Debra K. Sullivan

Your child's grade level (circle one): 3 4 5

_____ YES, I agree to have my child participate.

_____ NO, I do not want my child to participate in the snack nutrition program.

Parent Name: _____

Child's Name: _____

Address: _____

Telephone Number: _____

Dairy Foods and Blood Pressure in Multi-Ethnic Children

INTRODUCTION

As a parent with a third, fourth, or fifth grade student in the Kansas City, Kansas or Olathe School District, your child is being invited to participate in a study to determine if consuming 2 servings of dairy foods per day at school will affect his/her blood pressure. This study will be performed at your child's school by investigators from the University of Kansas Medical Center, Department of Dietetics and Nutrition.

PURPOSE

The primary objective for the study is to increase dietary intake of calcium by grade school children and evaluate the effect of the intervention on blood pressure. The secondary purpose will be to determine if the dairy snacks have any effect on your child's growth.

PROCEDURE

Your child's participation in this study will involve drinking or eating 2 servings of dairy foods as snacks or continuing to follow the current practice of receiving no snacks at school. Whether he/she receives the dairy or no snacks will depend on which school he/she attends. Half the schools will be randomly chosen to receive the dairy foods and the other schools will receive no snacks. If your child is at a school that receives the dairy snacks, he/she will need to consume the snack for one school year. If your child is at a school that receives no snacks, there will be no change at his/her school.

At the beginning, middle, and end of the year, he/she will be measured for height, weight, waist circumference, arm circumference, triceps skinfold, and blood pressure/heart rate. The blood pressure cuff may be uncomfortable and your child may say at any point that he/she wants to stop the testing. To see what your child is eating, you will help your child record what he/she eats and then he/she will use that record to tell the investigators everything that he/she ate for one day. You and your child will do this for one day at the beginning, middle, and end of the school year. Your child will also fill out two short questionnaires at the beginning and end of the school year. One questionnaire will ask him/her which foods he/she eats more often, which food he/she would rather eat, which foods are healthier, etc. The other questionnaire will ask him/her how much physical activity he/she does on most days. You will also be asked to fill out a short Medical History form for your child and yourself at the beginning of the study. This is to make sure there are no medical conditions or medications that may interfere with the study or health of your child.

To see if the snacks have any long term effect, your child will have his/her blood pressure/heart rate taken and will complete a record of his/her diet for 3 days in the fall and spring of the following school year. Administering the snacks will take approximately 10 minutes from your child's school academic day. Snack consumption will occur during class time in order to minimize disruption of academic time. The physical measurement will require approximately twenty minutes of time at baseline, midway, and conclusion of the study. Recording what your child eats will take approximately 20 minutes for each day. The time required to conduct the measurements of this study will be incorporated into your child's curriculum (science) to minimize disruption of academic learning. All measures will occur at your child's school.

RISKS
There are no risks to your child in this study. He/she may feel some abdominal discomfort if he/she is lactose intolerant and in the group receiving dairy products. He/she does not have to eat or drink the milk product(s) if it causes discomfort. Lactose free milk or other tolerable dairy foods will be provided. The physical measurements will not hurt your child, but he/she may feel a small pinch when his/her triceps skinfold is measured. He/she may feel pressure from the blood pressure cuff. He/she may stop the test at any time. This study may decrease the time your child has for academic lessons, but the time will be minimized and incorporated into learning activities when possible.

BENEFITS
Your child may receive a nutritious snack for free for one school year. Foods high in vitamins and minerals are known to have positive health benefits. You will receive a printout with your child's results from the testing.

PAYMENT TO SUBJECTS
Neither you nor your child will receive payment for participation in this study.

COSTS
There are no costs involved in participating in this study.

ALTERNATIVES
Your child may continue to eat or drink the snacks even if he/she no longer chooses to participate in the study or refuses to complete certain parts of the study.

INSTITUTIONAL DISCLAIMER STATEMENT
If you believe that you have been injured as a result of participating in research at Kansas University Medical Center (KUMC), you should contact the Director, Human Research Protection Program, Mail Stop #1032, University of Kansas Medical Center, 3901 Rainbow Blvd., Kansas City, KS 66160. Compensation to persons who are injured as a result of participating in research at KUMC may be available, under certain conditions, as determined by state law or the Kansas Tort Claims Act.

CONFIDENTIALITY AND PRIVACY AUTHORIZATION
Study records that identify your child will be kept confidential as required by law. Researchers cannot guarantee absolute confidentiality; however, efforts will be made to keep your child's personal information confidential. If the results of this study are published or presented in public, information that identifies your child will be removed.

The privacy of your child's health information is protected by a federal law known as the Health Insurance Portability and Accountability Act (HIPPA). By signing this consent form, you are giving permission for KUMC to use and share your child's health information for purposes of this research study. If you decide not to sign the form, your child cannot be in the study.

To do this research, the research team needs to collect health information that identifies your child. Your child may be identified by information such as name, date of birth, or other identifiers. The research team will collect information from study activities described in the Procedures section of this form. Your child's study health information will be reviewed by the principal investigator Debra Sullivan, Ph.D., R.D., members of her research team, the Research Institute, and the Human Subjects Committee at KUMC. These offices review research studies to protect study participants like your child.

By signing this form, you are giving Dr. Sullivan and her research team permission to share information from this study with the National Institutes of Health (the sponsor of the study) and federal agencies that oversee research.

Some of the persons or groups who receive your child's study information, including the sponsor, may not be required by law to protect it. Once your child's information has been shared outside of KUMC, it may be disclosed by others and no longer protected by the federal privacy laws or this authorization.

The permission that you give us today to use your child's study information will not expire unless you cancel it. In other words, you are giving permission for us to use your child's study information at any time in the future.

QUESTIONS

Before you sign this form, Dr. Sullivan or her associates should answer your question(s) to your satisfaction. If you have any more questions, concerns, or complaints after signing this form, you may contact Dr. Debra Sullivan at (913) 588-5357 or Dr. Cheryl Gibson at (913) 588-7202. If you have any questions about your child's rights as a research subject, you may call (913) 588-1240 or write the Human Subjects Committee, Mail Stop #1032, University of Kansas Medical Center, 3901 Rainbow Blvd., Kansas City, KS 66160.

SUBJECT RIGHTS AND WITHDRAWAL FROM THE STUDY

Your child's participation in this study is voluntary. The choice not to participate or to quit at any time can be made without penalty or loss of benefits. These decisions will have no effect on your child's future medical care. The study may be stopped for any reason without your consent by the investigator conducting the study or by the sponsor the National Institutes of Health. Your child's participation can be discontinued by the investigator or the sponsor if it is felt to be in your child's best interest or if he/she does not follow the study requirements.

You have the right to change your mind about allowing the research team to have access to your child's study information. To cancel your permission, you must send a written request to Dr. Sullivan at the University of Kansas Medical Center, Department of Dietetics and Nutrition, 3901 Rainbow Boulevard, Mail Stop 4013, Kansas City, KS 66160.

If you cancel permission to use your child's study information, your child will be withdrawn from the study. The investigator may continue to use your child's study information that was gathered prior to your cancellation, however, no additional information will be collected.

CONSENT

Dr. Sullivan or her associates have given you information about this research study. They have explained what will be done to your child, what your child will have to do, how it will be done, and how long it will take. They also explained any inconvenience, discomfort or risks that your child may experience during this study.

You freely and voluntarily consent to allow your child to participate in this research study. You have read the information in this form and have had an opportunity to ask questions and have them answered. **You will be given a signed copy of this consent form to keep for your records.**

_____

Type/Print Parent or Legal Guardian Name

_____ _____

Signature of Parent or Legal Guardian Date

Assent for Minor Child

Your parents have given you permission to be part of a study about how eating snacks at school affects your blood pressure and growth. If you want to be part of the study, you will need to eat the snacks given to you at school. You will receive the snacks for 6 months. Before the research study starts at school you will have your blood pressure/heart rate, height, weight, waist and arm size and body fat measured. Your body fat will be measured by pinching the back of your upper arm. After the research study starts, you will have your blood pressure, weight, height, waist and arm size, and body fat measured after 3 months of the study and again at the end. You will also have to tell us everything you ate or drank for one whole day and answer some questions about foods you regularly eat at the beginning, middle, and end of the study. If you sign your name to the line it means that you want to be part of the research. You know that you do not have to do it and that you can stop being in the research at any time you want even if you signed the paper. If you want to stop all you need to do is tell your parents or call the investigator at 588-5357.

Name of Child: _____

Signature of Child: _____

Date: _____

Age of Child: _____

HSC# 8586
HSC Approval Date 7/2/08 - 2/18/09
Assurance #FWA00003411

KUMC KIDS STUDY
Child Medical History Form

Administrative Use Only	
Student ID: ____ ____ ____ ____	**School ID:** ____ ____ ____

This survey is confidential and all information will only be used for the purposes of this study. There are not right or wrong answers and you may choose not to answer any of the questions.

Name of Child: _____

Child's Age: ___ ___

Name of School: _____

Child's Date of Birth: __ __ / __ __ / __ __ __ __

Child's Grade (check one): ____ 3rd ____ 4th ____ 5th

Child's Gender (check one): ____ male ____ female

Teacher's Name: _____

What race do you consider your child to be? Select all that apply.

_____ White
_____ Black
_____ Hispanic
_____ Asian
_____ Native Hawaiian/Pacific Islander
_____ American Indian/Alaskan Native
_____ Other (please explain)_____

In general, how would you rate your child's health?

_____ Excellent
_____ Very Good
_____ Good
_____ Fair
_____ Poor

Medical History of Child

Has a doctor ever diagnosed your child with any of the following? (Check all that apply)

_____High Blood Pressure
_____Heart Disease
_____Kidney Disease
_____Obesity
_____Diabetes
_____ADD/ADHD
_____High Cholesterol
_____Asthma
_____Food Allergies
_____Lactose Intolerance (diagnosed by doctor)
_____Elevated Blood Lead Levels (diagnosed by doctor)
_____Other (please explain)_____

Please list all medications (including vitamins/supplements) that your child takes?

_____
_____
_____

Comments

_____
_____
_____

KUMC KIDS STUDY
Parent Medical History Form

Administrative Use Only	Student ID: ___ ___ ___ ___ School ID: ___ ___ ___	

This survey is confidential and all information will only be used for the purposes of this study. There are not right or wrong answers and you may choose not to answer any of the questions.

Caregiver # 1

Age: ___ ___ **Weight:** ___ ___ ___ . ___ (pounds) **Height:** ___ feet ___ ___ inches **Gender:** (check one) ____ male ____ female

What race do you consider yourself to be? Select all that apply:
_____ White
_____ Black
_____ Hispanic
_____ Asian/Pacific Islander
_____ American Indian/Alaskan Native
_____ Other (please explain)_____

Choose the highest level of education completed:
_____ Never attended school
_____ Less than 12 years
_____ Some college or Technical school
_____ Associate's degree
_____ Bachelor's degree
_____ Graduate school
_____ Other (please explain)_____

The child involved in this project is related to you by:
_____ Birth
_____ Adoption
_____ Stepchild
_____ Aunt/Uncle/Grandparent
_____ Foster Parent
_____ Other (explain)_____

Do you live with the child involved in this project?
_____ No
_____ Yes, all of the time
_____ Yes, some of the time

In general, how would you rate your health?
_____ Excellent
_____ Very Good
_____ Good
_____ Fair
_____ Poor

Has a doctor ever diagnosed you with any of the following? (check all that apply)
_____High Blood Pressure
_____Heart Disease
_____Kidney Disease
_____Stroke
_____Diabetes
_____High Cholesterol
_____ Obesity
_____ Asthma
_____Other (please explain) _____

Caregiver # 2

Age: ___ ___ **Weight:** ___ ___ ___ . ___ (pounds) **Height:** ___ feet ___ ___ inches **Gender:** (check one) ____ male ____ female

What race do you consider yourself to be? Select all that apply:
_____ White
_____ Black
_____ Hispanic
_____ Asian/Pacific Islander
_____ American Indian/Alaskan Native
_____ Other (please explain)_____

Choose the highest level of education completed:
_____ Never attended school
_____ Less than 12 years
_____ Some college or Technical school
_____ Associate's degree
_____ Bachelor's degree
_____ Graduate school
_____ Other (please explain)_____

The child involved in this project is related to you by:
_____ Birth
_____ Adoption
_____ Stepchild
_____ Aunt/Uncle/Grandparent
_____ Foster Parent
_____ Other (explain)_____

Do you live with the child involved in this project?
_____ No
_____ Yes, all of the time
_____ Yes, some of the time

In general, how would you rate your health?
_____ Excellent
_____ Very Good
_____ Good
_____ Fair
_____ Poor

Has a doctor ever diagnosed you with any of the following? (check all that apply)
_____High Blood Pressure
_____Heart Disease
_____Kidney Disease
_____Stroke
_____Diabetes
_____High Cholesterol
_____ Obesity
_____ Asthma
_____Other (please explain) _____

APPENDIX C:

KUMC KIDS data form

KUMC KIDS Data Collection Form

Administrative Use Only - Affix Label Here

Subject's Name: _____

Subject ID: _ _ _ _

Date/Period: _ _ / _ _ / _ _ _ _ (Baseline, 3 months, 6 months)

School/School ID: _____ / _ _ _ _

Teacher/Grade: _____ / _____ grade

Time

___ ___ : ___ ___ am / pm **(circle one)**

Age: ____ ____ years

Date of Birth (mo/day/year): _ _ / _ _ / _ _ _ _

Grade (circle one): 3rd 4th 5th

Gender (circle one): Boy Girl

What race do you consider yourself to be?
Select all that apply:

_____ White
_____ Black
_____ Hispanic
_____ Asian/Pacific Islander
_____ American Indian/Alaskan Native
_____ Other (please explain)_____

	Measurements	Unit	Comment (circle one if needed)	Initials
Height	1) ___ ___ ___ . ___ 2) ___ ___ ___ . ___ 3) ___ ___ ___ . ___	Cm	1. Refused 2. Unable to stand without support 3. Difficult to assess (e.g. hair) 4. Other: _____	___ ___
Weight	1) ___ ___ ___ . ___ 2) ___ ___ ___ . ___ 3) ___ ___ ___ . ___	Kg	1. Refused 2. Unable to stand without support 3. Shoes 4. Other: _____	___ ___
Waist Circumference	1) ___ ___ . ___ 2) ___ ___ . ___ 3) ___ ___ . ___	Cm	1. Refused completely 2. Excess clothing (i.e. sweatshirt) 3. Over Shirt: _____	___ ___
Mid-Arm Circumference	1) ___ ___ . ___ **right arm**	Cm	*Measure for Blood Pressure Cuff Size*	___ ___
Blood Pressure/ Heart Rate **(discard 1st measurement)**	Blood Pressure / Heart Rate 1) ___ ___ ___ / ___ ___ ___ ___ ___ 2) ___ ___ ___ / ___ ___ ___ ___ ___ 3) ___ ___ ___ / ___ ___ ___ ___ ___ 4) ___ ___ ___ / ___ ___ ___ ___ ___	mmHg **Circle Arm Used** **right left** **Machine Used** **A B C D**	1. Refused 2. Did not rest long enough 3. Will not stop fidgeting 4. Other: _____	___ ___
PAQ Complete	___ ___	**DQ complete**	___ ___ **Diet Recall Complete**	___ ___

Version 4 - 07/20/2008

APPENDIX D:

KUMC KIDS 24 hour recall form

KUMC KIDS STUDY

Subject Name/ID #_____ Date of Intake:_____

Testing Session: Baseline / 3 months / 6 months Attempt: 1 2 3

Weekday / Weekend Interviewer:_____ Entered_____ Checked_____

Time/Place	Meal	Food/Beverage Description	Amount

Time/Place	Meal	Food/Beverage Description	Amount

Was intake: Typical? Considerably more than usual? Considerably less than usual? Why?

_____

Was recall: Reliable? Unable to recall 1 or more meals? Unreliable for other reasons? Why?

_____

Vitamin/Mineral/Supplement Use/Dosage? _____

What time did you go to bed last night? _____

What time did you wake up this morning? _____

Is this your normal time to go to bed and time to get up in the morning? Please explain if not normal?

_____