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An Evaluation Of The Healthy Eating Active Living (Heal) Alabama Program For Prevention Of Childhood Obesity Among Fifth Grade Students

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AN EVALUATION OF THE HEALTHY EATING ACTIVE LIVING (HEAL) ALABAMA PROGRAM FOR PREVENTION OF CHILDHOOD OBESITY AMONG FIFTH GRADE STUDENTS

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A DISSERTATION

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HEALTH EDUCATION AND HEALTH PROMOTION

ABSTRACT

Childhood obesity is a major public health concern. The multiple effects of obesity in childhood are long-reaching. Since weight loss and maintenance are very difficult, prevention of obesity is important. Schools have been identified as an important environment for obesity prevention interventions since most children spend a large portion of the day at school. The purpose of this secondary data analysis was to determine if the Healthy Eating Active Living (HEAL) Alabama intervention improved weight status, fitness levels, and health knowledge and behaviors.

A 2-by-2 repeated measures ANOVA was performed to determine whether differences exist between intervention and comparison students at pretest and posttest. Measures that were explored included BMI Z-scores, Progressive Aerobic Cardiovascular Endurance Run (PACER) scores, nutrition knowledge and behavior scores, and physical activity knowledge and behavior scores.

Significant advances were observed among intervention students in contrast to comparison students from pretest to posttest for physical fitness (as measured by the PACER), and nutrition and physical activity knowledge. No significant improvements were found for weight status, nutrition behavior, or physical activity behavior. A high prevalence of obesity was observed at pretest. It may be difficult for a primary obesity prevention program to be successful among fifth grade students with such high

prevalence rates. A greater effect may be found when intervening with younger children. While schools alone cannot turn the tide on childhood obesity, it is unlikely that improvements can be made without the involvement of schools and programs such as HEAL.

Keywords: childhood obesity, school based intervention, physical activity, nutrition

DEDICATION

This work is dedicated to my husband and personal IT consultant, J.T. Hart. I offer my deepest expression of love and appreciation for the support and encouragement you gave and the sacrifices you made throughout the graduate program. In years to come, I hope we can laugh at the truth of Ecclesiastes 12:12, "…Of making many books there is no end, and much study wearies the body."

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ADA	American Dietetic Association (now the Academy of Nutrition and Dietetics)
AND	Academy of Nutrition and Dietetics
BMI	body mass index
CCT	controlled clinical trial
CDC	Centers for Disease Control and Prevention
DEXA	dual energy x-ray absorptiometry
FPL	Federal Poverty Level
HEAL	Healthy Eating Active Living
NHANES	National Health and Nutrition Examination Survey
NICE	National Institute for Health and Clinical Excellence
NSCH	National Survey of Children's Health
NSLP	National School Lunch Program
OR	odds ratio
PACER	Progressive Aerobic Cardiovascular Endurance Run
PE	physical education
RCT	randomized controlled trial
SEM	Social Ecological Model
SES	socioeconomic status
SMD	standardized mean differences

UK	United Kingdom
US	United States
USDA	United States Department of Agriculture
WHO	World Health Organization

LIST OF KEY TERMS

Body mass index (BMI)	A number calculated using a person's height and weight. Body mass index (BMI) is a reliable indicator of body fatness for most people.
Body mass index-for-age	Percentile which indicate the relative position of a child's (BMI-for-age) BMI number among children of the same gender and age.
Body mass index z-score	A measure of relative weight adjusted for a child's age and gender; also known as BMI standard deviation score.
Healthy Eating Active Living (HEAL)	A community-initiated (Non-profit 501c3) physical education program that seeks to improve fitness and increase knowledge and behaviors regarding physical activity, nutrition, and disease prevention.
High minority school	School with greater than 50% minority students.
High poverty school	School with 76% or more students receiving free or reduced lunch.
Low minority school	School with less than 5% minority students.
Low poverty school	School with 25% or fewer students receiving free or reduced lunch.
Medium minority school	School with 5 – 50% minority students.
Medium poverty school	School with 26 – 75% students receiving free or reduced lunch.
Obese	In children, a BMI-for-age percentile at or above the 95^{th} percentile.
Overweight	In children, a BMI-for-age percentile above the 85^{th} percentile and below the 95% percentile.
PACER	Progressive Aerobic Cardiovascular Endurance Run; a 20 meter shuttle run used to examine aerobic capacity.

CHAPTER 1

STATEMENT OF THE PROBLEM

Throughout the world childhood obesity rates have reached epic levels (Janssen et al., 2005). The 2010-2011 National Survey of Children's Health indicated the prevalence of childhood obesity among children ages 10-17 years was 15.7%; however, Alabama fared worse with 18.6% of children in this age group considered obese (National Survey of Children's Health, n.d.). Using 2009-2010 National Health and Nutrition Examination Survey data, Ogden, Carroll, Kit, & Flegal (2012) observed 16.9% of children ages 2-19 are considered obese.

Childhood obesity presents both immediate and long-term problems. Children who are overweight or obese are more likely to be overweight or obese as adults (Centers for Disease Control and Prevention, 2011a; Garn & LaVelle, 1985; Singh, Mulder, Twisk, van Mechelen, & Chinapaw, 2008; Whitaker, Wright, Pepe, Seidel, & Dietz, 1997). Since obesity increases the risks for diabetes mellitus, cardiovascular disease, and other chronic conditions, overall life expectancy may be reduced (Fontaine, Redden, Wang, Westfall, & Allison, 2003). A greater incidence of type 2 diabetes has been reported among obese children and adolescents (Fagot-Campagna, Narayan, & Imperatore, 2001; Must & Anderson, 2003); this onset of diabetes can lead to complex complications including cardiovascular disease and kidney failure (Must & Anderson, 2003).

Increased risk of cardiovascular disease among obese children and adolescents is revealed by elevated total cholesterol, trigylcerides, insulin, and/or resting blood pressure (Freedman, Mei, Srinivasan, Berenson, & Dietz, 2007). Although less prevalent, health problems including asthma, hepatic steatosis (i.e., fatty liver), sleep apnea, gallbladder disease, endocrine dysfunction, and musculoskeletal disorders have also been associated with childhood obesity (Daniels, Jacobson, McCrindle, Eckel, & Sanner, 2009).

In addition to physical problems, childhood obesity has psychosocial consequences. Children and adolescents who are obese may experience early and systematic social discrimination from peers (Latner & Stunkard, 2003; Richardson, Goodman, Hastorf, & Dornbush, 1961; Staffieri, 1967). Being embarrassed and ashamed of their weight, these children are more prone to develop feelings of self-blame and low self-esteem (Schwartz & Puhl, 2003). Research suggests a likely association of school absences and poor peer relationships with overweight and obesity. Results of one study revealed that overweight and obese children were absent more frequently than children at a normal weight (Geier et al., 2007). Additionally, when Schwimmer, Burwinkle, & Varni (2003) administered a pediatric quality of life inventory (PedsQL 4.0), children and adolescents who were extremely obese had scores that identified quality of life measures similar to those of children with cancer.

Etiology of Childhood Obesity

In the most basic view, childhood obesity results from an imbalance between energy consumed through food and energy expended through activity. However, this imbalance occurs due to a complex intermingling of genetic and behavioral factors (U.S. Department of Health and Human Services, 2001a, World Health Organization, 2000).

The role of genes in influencing body size and obesity is not fully understood; however, it appears that there may be numerous heritable factors capable of exerting effects through energy intake and energy expenditure as well as the processes by which nutrients are stored as either fat or lean tissue (Farooqi & O'Rahilly, 2007).

Behavior plays a critical role in the development of childhood obesity. In 2007, Barlow and an expert committee published recommendations in *Pediatrics* for evidence-based target behaviors related to childhood obesity. These recommendations were developed by experts in various fields including medicine, nutrition, nursing, psychology, and epidemiology who represented 15 member organizations. During the review of available literature, the committee categorized target behaviors as:

- *Recommended with consistent evidence*, meaning that multiple studies found consistent associations between the behavior and risk of obesity or energy balance;
- *Recommended with mixed evidence*, indicating that some studies revealed an association among target behaviors and weight status while others failed to show a significant association, that few studies were available, or that studies had a small sample size; or
- *Suggested*, when there were no clear findings regarding associations between targeted behaviors and weight status, but the recommendations could support desired weight while providing additional benefits with no foreseeable harm.

The expert committee found consistent evidence to recommend limiting consumption of sugar-sweetened beverages, limiting screen time (including television) to no more than two hours for children two years of age and older and removing televisions and

other screens from children's primary sleeping area. Further, the committee recommended eating breakfast daily, limiting dining at restaurants (especially fast food restaurants), supporting family meals in which parents and children eat together, and limiting portion size. Promoting diets rich in fruits and vegetables was recommended with mixed evidence. Finally, behaviors suggested by the expert committee included eating a diet rich in calcium, consuming a diet high in fiber, eating a diet with balanced macronutrients, encouraging breastfeeding exclusively until six months of age and maintaining breastfeeding after introduction of solid food to twelve months of age and beyond, promoting a minimum of 60 minutes each day of moderate to vigorous physical activity, and limiting consumption of energy-dense foods (Barlow & the Expert Committee, 2007). Staniford, Breckon, and Copeland (2012) conducted a systematic review of childhood obesity treatments with results published from 2000 to 2009. The researchers recommended using a whole family approach for targeting physical activity and dietary behavior change and implementing behavioral change plans that include goal setting, self-monitoring, and stimulus control.

Addressing Childhood Obesity in Schools

Childhood obesity is the result of multiple determinants, i.e. genetic, metabolic, behavioral, environmental, cultural, and socioeconomic (U. S. Department of Health and Human Services, 2001b). Numerous settings have been identified as useful in addressing childhood obesity. In *The Surgeon General's Vision for a Healthy and Fit Nation* (U. S. Department of Health and Human Services, 2010a), Surgeon General Regina Benjamin identified environments for planned intervention to improve the weight, and health, status

of Americans; settings include the family home, child care centers, schools, work sites, medical communities, and neighborhoods and communities.

Schools are uniquely positioned for obesity prevention programs, since the majority of children are enrolled each day. Healthy habits (eating nutritious foods and being physically active) can be introduced and reinforced (U. S. Department of Health and Human Services, 2001b). The *Let's Move* campaign led by First Lady Michelle Obama identifies schools as agents in reducing the prevalence of childhood obesity. The *Let's Move* initiative was launched in 2010 with the aim of reducing childhood obesity and creating a healthier generation of young people by addressing multiple pillars including early childhood obesity prevention, parent and caregiver empowerment, healthier foods in schools, access to healthy, affordable foods, and increased physical activity. In the school setting, principals, teachers, and parents are encouraged to create healthier school environments by delivering quality nutrition, incorporating physical activity during the day, and teaching children the benefits of adopting a healthy, active lifestyle. Specific action steps that are recommended for principals, teachers, and parents include: creating a school health advisory council, joining the HealthierUS School Challenge, setting a good example, integrating physical education and nutrition education into the school day, and planting a garden (*Let's Move,* n.d.).

Selected schools within Alabama have implemented the Healthy Eating Active Living (HEAL) curriculum developed by experienced educators. The HEAL curriculum is taught to fifth grade students during physical education (PE) classes. While surpassing the state standards for PE, the program promotes healthy student bodies through education about motor skills and healthy lifestyle behaviors. Heart rate monitors provide

feedback to students and instructors. Data from a pilot study found favorable outcomes for overall fitness, weight status, and eating behaviors (Healthy Eating Active Living Alabama, n.d.).

PURPOSE OF THE STUDY

The purpose of this study was to determine whether the HEAL curriculum improves weight status of children receiving the curriculum. The study was a secondary analysis of existing data collected by the HEAL Team of educators during the 2010-2011 school year. Pretest and posttest assessments were gathered from approximately 600 students in intervention and comparison schools.

Research Questions

- Does the HEAL PE curriculum improve weight status of fifth grade students as evidenced by body mass index (BMI) Z-scores when compared to scores from students enrolled in comparison schools?
- Does the HEAL PE curriculum improve fitness levels of fifth grade students as evidenced by PACER (Progressive Aerobic Cardiovascular Endurance Run) test scores when compared to scores from students enrolled in comparison schools?
- Does the HEAL PE curriculum improve physical activity knowledge as evidenced by physical activity knowledge questionnaire scores when compared to scores from students enrolled in comparison schools?
- Does the HEAL PE curriculum improve nutrition knowledge as evidenced by nutrition knowledge questionnaire scores when compared to scores from students enrolled in comparison schools?

- Does the HEAL PE curriculum improve physical activity behaviors of fifth grade students as evidenced by behavior questionnaire scores when compared to scores from students enrolled in comparison schools?
- Does the HEAL PE curriculum improve nutrition behaviors of fifth grade students as evidenced by behavior questionnaire scores when compared to scores from students enrolled in comparison schools?

Assumptions

There are two assumptions of the proposed study:

1. Students accurately reported their behaviors and knowledge on the HEAL questionnaire.
2. Students in the intervention and comparison groups are representative of fifth grade students in Alabama.

Limitations

Limitations of the data collected from students may include contamination. Although assignment to HEAL study group was by school, the national aim to reduce prevalence of childhood obesity and the plethora of guidelines available for weight management cannot be ignored. Therefore, comparison students may have been exposed to messages encouraging physical activity and healthy eating habits. In addition, no objective measures were utilized for assessing physical activity or nutritional behaviors; instead, student self-report was used.

Significance of the Study

The evaluation of the HEAL curriculum may provide valuable information to HEAL developers and stakeholders. Results provide evidence regarding the efficacy of

the program for improving weight status, fitness levels, knowledge, and behaviors among fifth grade students in Alabama. HEAL curriculum developers may use findings from this study to improve the curriculum, materials, and teacher training. HEAL financial supporters can examine the assessment of the program, and health educators may consider study results before adopting the HEAL curriculum.

CHAPTER 2

REVIEW OF LITERATURE

The prevalence of childhood obesity has increased dramatically over the past four decades. Five percent of children 2-19 years of age were obese during 1971-1974 (Ogden, Flegal, Carroll, & Johnson, 2002) whereas 16.9% of children met the criteria for obesity during 2009-2010 (Ogden, Carroll, Kit, & Flegal, 2012). Similarly, prevalence of obesity increased from 4% during 1971-1974 (Ogden et al., 2002) to 18% during 2009-2010 for children 6-11 years of age (Ogden et al., 2012).

Fifth grade students are commonly 10-11 years old, placing them in the middle childhood and early adolescent stages of life. Middle childhood has been defined as 5-10 years of age, and early adolescence is considered 11-14 years of age (Hagan, Shaw, & Duncan, 2008). As a whole, middle childhood is marked by slow, steady growth. During this time, children average gains of two inches in height and 6.5 pounds of weight per year. Actual growth varies based on numerous factors, including how close a child is to puberty (American Academy of Pediatrics, 2012).

The onset of puberty for girls is about 10 years of age whereas boys begin puberty around 11 years of age (American Academy of Pediatrics, 2008). Five primary physical indicators of puberty include rapid growth acceleration that leads to significant height and weight increases; the development of primary sex characteristics, such as further development of testes in boys and ovaries in girls; the development of secondary sex

characteristics like changes in genitals and breasts and growth of pubic, facial, and body hair; changes in body composition affecting the amount and distribution of fat and muscle; and changes in the circulatory and respiratory systems that produce increased strength and tolerance for physical activity (Marshall, 1978). Among girls, maximal growth rate is achieved around 6-12 months before menarche. A growth spurt is seen later in boys, and growth spurts among boys produce greater peak height velocity than girls (Hagan et al., 2008). Peak height velocity averages 3.5 inches per year for girls and 4.1 inches per year for boys (Tanner, 1972). To assess weight status in children and adolescents, body mass index (BMI) and BMI-for-age are used.

Body Mass Index (BMI) and BMI-For-Age

An individual's body mass index, or BMI, is a number generated based on height and weight. Calculation of BMI can be performed using either of these two formulas:

$$\text{BMI} = \text{Weight (kg)} \div \text{Stature (cm)} \div \text{Stature (cm)} \times 10{,}000$$

or

$$\text{BMI} = \text{Weight (lb)} \div \text{Stature (in)} \div \text{Stature (in)} \times 703$$

(CDC, n.d.a) This number is then used to assess health risks. While BMI does not measure body fat directly, it appears to correlate with direct measures of body fat obtained through precise methods such as dual energy x-ray absorptiometry (DEXA) or underwater weighing (Mei, Grummer-Strawn, Pietrobelli, Goulding, Goran, & Dietz, 2002). Barlow and Dietz (1998) observed that BMI-for-age is significantly associated with total body fat and subcutaneous fat. BMI calculation is an easy and inexpensive method for screening potential health risks related to weight (CDC, 2011b).

The estimation of health risks based on weight for adults is based on the actual calculated BMI. For adults, a BMI below 18.5 indicates underweight, BMIs between 18.5 and 24.9 denote a healthy weight, BMIs between 25.0 and 29.9 suggest overweight, and BMIs greater than 30.0 imply obesity. In children, the BMI value changes significantly over childhood; therefore, BMI-for-age, which is age and gender specific is used (Hammer, Kraemer, Wilson, Ritter, & Dornbusch, 1991; Pietrobelli, Faith, Allison, Gallagher, Chiumello, & Heymsfield, 1998).

In 1997, a consensus panel recommended the routine use of BMI-for-age as a method to screen children's weight status (Barlow & Dietz, 1998). Similarly, in 1997, the International Obesity Task Force identified BMI as an appropriate practice to screen for overweight in children and adolescents (Deitz & Bellizzi, 1999).

To assess a child's BMI-for-age, BMI is calculated; the value is then plotted on an appropriate CDC Growth Chart (CDC, 2010). Plotting the value involves identifying the point at which the child's BMI and age intersect on the chart. Once the value is plotted, the BMI-for-age percentile can be read by observing the percentile position of the plotted value (CDC, n.d.a). Determination of weight status is made by comparing the child's percentile to established weight categories. Children below the 5^{th} percentile of BMI-for-age are considered underweight, and children with BMI-for-age between the 5^{th} and 84^{th} percentile are at a healthy weight. Overweight is defined as having a BMI-for-age between the 85^{th} and 94^{th} percentile, and children at the 95^{th} percentile or higher meet the criteria for obesity (CDC, 2011c).

Determinants of Childhood Obesity

In the most basic view, childhood obesity results from an imbalance between energy consumed through food and energy expended through activity. However, this imbalance occurs due to a complex intermingling of genetic and behavioral factors (U.S. Department of Health and Human Services, 2001b, World Health Organization, 2000). The role of genes in influencing body size and obesity is not fully understood; however, it appears that there may be numerous heritable factors that are capable of exerting effects through energy intake and energy expenditure as well as the division of nutrients between fat and lean tissue (Farooqi & O'Rahilly, 2007).

Genetics and childhood obesity

Important studies that showed a genetic influence on body size explored the similarities between 1) adoptees and their adoptive parents, biological parents, and their siblings and 2) twins reared together. When body mass index of adult adoptees was examined, it was found to be similar to their biological parents (Price, Cadoret, Stunkard, & Troughton, 1987) and biological siblings (Sorensen, Price, Stunkard, & Schulsinger, 1989) but dissimilar to that of the adoptive parents. Researchers in studies of twins who were reared together observed that genetic contributions may account for 64-84% of variability in body size (Feinleib et al., 1977; Stunkard, Harris, Pederson, & McClearn, 1990); however, the impact of the shared environment was unclear.

More recently, researchers have considered specific genes that influence body size and the mechanism by which they exert influence. Bouchard (2007) examined 22 genes implicated in expression of obesity within five or more studies. These genes were

then considered in light of the biological or behavioral impact that they may exert. From that examination, five genotype classes seemed to surface. Those genotypes include:

- "a thrifty genotype: a low metabolic rate and insufficient thermogenesis;
- a hyperphagic genotype: poor regulation of appetite and satiety and propensity to overfeed;
- a sedens genotype: propensity to be a low lipid oxidizer; and
- an adipogenesis genotype: ability to expand complement of adipocytes and high lipid storage capacity." (p. 1338)

Further research into these different genotypes may help to unlock the answers to how genes influence obesity and body size.

Health Behaviors

Although a genetic predisposition to weight is well-recognized, it is highly unlikely to be responsible for the rapid increase in childhood overweight prevalence. This suggests that the diet and physical activity of children play a significant role in the development of childhood overweight (Hill & Trowbridge, 1998). In most cases of overweight and obesity there is an excess energy intake and/or insufficient physical activity (U.S. Department of Health and Human Services, 2001b).

Children in the United States are eating more energy-dense foods while engaging in less physical activity than 20-30 years ago, according to the Academy of Nutrition and Dietetics (2006a). During the past 2-3 decades, eating patterns among families have shown an increased reliance on meals prepared outside of the home. Eating away from home appears to be associated with increased intake; an estimated 200 additional calories per day are consumed when foods are eaten away from home when compared to eating

the same foods at home (French, Story & Jeffery, 2001). Frequently these meals are eaten at fast food restaurants, as foods available from these establishments are generally cheap and available in large amounts (Hill & Trowbridge, 1998; Harnack, Jeffery & Boutelle, 2000).

Both portion size and frequency of eating opportunities appear to increase intake. When preschool children were given double the age-appropriate portion of an entrée, intake increased by 25% for the entrée and 15% for the meal. This increased intake was seen despite gender and age (Fisher, Rolls, & Birch, 2003). In one study of 16 preschool children, researchers found that energy intake was positively associated with the number of eating episodes, number of foods consumed, and the portion sizes of foods offered (McConahy, Smiciklas-Wright, Mitchell, & Picciano, 2004).

Soda intake contributes to the increased intake of energy among children and adolescents. Studies indicate that soda consumption is related to adiposity in youth (Berkey, Rockett, Field, Gillman, & Colditz, 2004, Ebbeling, Feldman, Osganian, Chomitz, Ellenbogen, & Ludwig, 2006). The majority of adolescents, 65% of girls and 74% of boys, drink sodas daily (Borrud, Enns, & Mickle, 1997). Most of the sodas consumed are sugar-sweetened (Harnack, Stang & Story, 1999); as a result, they provide additional energy but no other nutritional value. Ludwig, Peterson, and Gortmaker (2001) found that for each additional can or glass of sugar-sweetened drink, the odds of a child becoming overweight increased by 1.6 times. The Academy of Nutrition and Dietetics (2006a) stated that there is strong evidence of a positive association between the consumption of sugar-sweetened drinks and BMI in children.

A low consumption of fruits and vegetables has been noted among children in the United States. Fruits and vegetables provide sources of numerous nutrients while being low in calories. In 2004, the CDC identified that nearly 80% of high school students fail to meet the recommended intake of fruits and vegetables. In a nationally representative study, an association was seen between a low intake of fruits and overweight for both girls and boys. A lower intake of vegetables was associated with overweight in boys only (Lin & Morrison, 2002). Though an inverse relationship between vegetable intake and BMI was not observed in girls, this may be due in part to the vegetables that are being consumed. More than one-third of the total daily intake of vegetables in the United States food supply come from iceberg lettuce, frozen potatoes (most commonly French fries), and potato chips (Academy of Nutrition and Dietetics, 2006a).

Breakfast skipping may be a risk factor for increased BMI for children and adolescents as well as poorer school performance and behavior problems (Wrotniak, Epstein, Paluch, & Roemmich, 2005). The Academy of Nutrition and Dietetics (2006a) noted that overweight children and adolescents were more likely to skip breakfast than peers at a normal weight. Overweight children also appeared to eat smaller breakfasts than normal weight peers.

Physical activity has fallen significantly among children and adolescents. This is particularly concerning because patterns of physical activity appear to follow into adulthood (Malina, 1996; Sallis, 2000). Gender differences have been observed in physical activity, with girls typically engaging is less vigorous physical activity during free time, in organized physical activity, during school, and away from school (National Center for Chronic Disease Prevention and Health Promotion, 1996). In a systematic

review of observational studies, Jimenez-Pavon, Kelly, and Reilly (2009), observed that a low level of physical activity was associated with childhood obesity risk. Physical activity expends energy (i.e., calories) and helps maintain a healthy weight; in addition, physical activity increases muscle and bone strength and increases lean muscle mass and aids in decreasing body fat.

Time spent in physical activity seems to have been usurped by sedentary behaviors such as television viewing, computer use, video gaming, along with other small-screen recreation and other low intensity/low energy-expenditure activities. In a 2004 systematic review of observational and experimental studies, Marshall and colleagues observed greater hours of screen time associated with risk of childhood obesity. Researchers studying sedentary behaviors have observed that the amount of time spent in sedentary activities is independently associated with increased obesity (Andersen, Crespo, Bartlett, Cheskin, & Pratt, 1998; Jago, Baranowski, Thompson, & Greaves, 2005). Similarly, Dennison, Erb, and Jenkins (2002) found that the presence of a television set in a child's bedroom is a strong marker of increased risk of obesity. Not only is television viewing a sedentary activity that may replace physical activity, viewers are also exposed to many marketing messages. On average a child is exposed to 40,000 commercials each year. Of the advertising aimed at children, 80% fits into four categories: fast food restaurants, cereals, candies, and toys (Kunkel & Gantz, 1992). It is reasonable to assume that these commercials influence food requests and food choices among children.

Sleep patterns are now being recognized as factor in childhood obesity. In a prospective cohort study, Al Mamus and colleagues (2007) observed short sleep intervals

in childhood were associated with greater childhood obesity risk. The risk for obesity is almost three times greater for children sleeping less than 8 hours per night (Sekine et al., 2002), and habitual short sleep duration can lead to increases in BMI in adolescent females in the same year (Berkey, Rockett, & Colditz, 2008). Sleep deprivation can lead to increased hunger, especially for high energy-dense foods (Spiegel, Leproult, L'Hermite-Balerizux, Copinschi, Penev, & Van Cauter, 2004). Inadequate sleep has also been related to decreased physical activity among adolescents (Gupta, 2002).

Besides genetics and heritability, the family has additional influences on obesity-related behaviors. In a 2007 review of 58 papers, van der Horst and colleagues found fairly consistent associations between parental intake and children's intake of fats, fruits, and vegetables. Higher frequency of meals eaten together as a family has been related to greater availability of healthy foods and healthier intake among children and adolescents (Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008). Hammons and Fiese (2011) observed that sharing family meals at least 3 times per week reduces the chance of obesity. As rule-setters and guides, parents also influence sleep behavior in children through the setting and monitoring of bedtimes and the removal of computers, cell phones, and televisions from bedrooms. Sleep duration appears to be related to practices that encourage social maturity (Spilsbury, Storfer-Isser, Drotar, Rosen, Kirchner, Benham, & Redline, 2005).

Childhood Obesity Disparities

Racial and Ethnic Disparities

Differences in childhood obesity prevalence by race and ethnicity have been reported in the literature (Flores, 2010; Hedley, Ogden, Johnson, Carroll, Curtin, &

Flegal, 2002; Oberg & Rinaldi, 2006). Recent studies were conducted to examine these disparities.

The National Survey of Children's Health (NSCH), sponsored by the Maternal and Child Health Bureau of the Health Services Administration, allows researchers to examine the physical and emotional health of children ages 0-17 years (CDC, 2012a). A query of the 2007 and 2010-2011 NSCH data indicated a decrease in childhood obesity rates for the United States and an increase for Alabama. Decreases in childhood obesity rates were identified for both non-Hispanic white and non-Hispanic black nationwide and for non-Hispanic white children in Alabama. An increase of childhood obesity prevalence among non-Hispanic black children in Alabama as presented in Table 1. In 2010-2011 throughout the nation, 12.1% of non-Hispanic white children were obese and 23.1% of non-Hispanic black children were obese. Within Alabama, 12.5% of non-Hispanic white children and 30.3% of non-Hispanic black children were obese (National Survey of Children's Health, n.d.).

Table 1

Childhood Obesity Rates in the US and Alabama

	US		Alabama	
	2007	2010-2011	2007	2010-2011
Overall	16.4%	15.7%	17.9%	18.6%
		By Race/Ethnicity*		
Non-Hispanic White	12.9%	12.1%	15.0%	12.5%
Non-Hispanic Black	23.8%	23.1%	22.3%	30.3%

Note. Adapted from 2007 and 2010-2011 National Survey of Children's Health. National Survey of Children's Health. NSCH 2007. NSCH 2010-2011. Child and Adolescent Health Measurement Initiative, Data Resource Center for Child and Adolescent Health website. Retrieved May 15, 2013 from www.nschdata.org.
*Sample sizes of Hispanic, multi-racial, non-Hispanic, and Other children were too small for reliable estimates.

In a 2012 article (Schuster et al., 2012) the authors examined differences by race and ethnicity of 16 measures including witnessing of violence, peer victimization, perpetration of aggression, seat-belt use, bike-helmet use, substance use, discrimination, terrorism worries, vigorous exercise, obesity, and self-rated health status and psychological and physical quality of life. Potential mediators of racial and ethnic disparities were tested. Data were collected from August 2004 through September 2006 for Healthy Passages, a study conducted with 5th grade students enrolled in public schools in and around Birmingham, Houston, and Los Angeles County (Windle et al., 2004). Parents of participants reported socioeconomic characteristics including marital status, highest educational level in household, and annual household income. Researchers measured each participant's height and weight for calculation of BMI and identification of obesity. Students reported the remainder of measures.

The unadjusted comparison of obesity among racial and ethnic groups showed a significant difference ($p < .001$) in obesity prevalence among non-Hispanic white children compared to non-Hispanic black and Latino children. The prevalence of obesity was 17% for non-Hispanic white children, 29% for non-Hispanic black children, and 32% among Latino children.

Adjusted models controlled for highest education in household (categorical), annual household income (categorical), parental marital status, age and gender of child, and child's school. Using the adjusted model, the difference in obesity prevalence when compared to non-Hispanic white children remained significant for non-Hispanic black children ($p < .01$) and for Latino children ($p < .001$). For both non-Hispanic black and Latino children, household income level and education were the most powerful

mediators. The child's gender and age as well as marital status of parent were observed to be mediators for both non-Hispanic black and Latino children, although the child's school was a mediator only for Latino children.

The National Health and Nutrition Examination Survey (NHANES) is used to examine the health and nutritional status of adults and children in the US through interviews and physical examinations. NHANES is conducted through the National Center for Health Statistics, a research center of the CDC, which is responsible for providing vital and health statistics for the nation (CDC, 2012b). Ogden et al. (2012) explored the prevalence of obesity among children ages 2-19 from 2009 to 2010. Gender-specific multiple logistic regression models were used to test differences by race/ethnicity and age. Differences of obesity prevalence were found among racial/ethnic groups. Data presented in Table 2 reveals that 14.0% of non-Hispanic white children were obese compared to 24.3% of non-Hispanic black children and 21.2% for Hispanic children in 2009-2010.

Table 2

Obesity Rates in Children 2-19 Years of Age in the US during 2009-2010 by Race/Ethnic Group

Race/ethnic group	Boys and Girls	Boys	Girls
All racial/ethnic groups	16.9%	18.6%	15.0%
Hispanic	21.2%	23.4%	18.9%
Mexican American	21.2%	24.0%	18.2%
Non-Hispanic white	14.0%	16.1%	11.7%
Non-Hispanic black	24.3%	24.3%	24.3%

Note. Adapted from Ogden, C.L., Carroll, M.D., Kit, B.K., and Flegal, K.M. (2012). Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. *Journal of the American Medical Association, 307(5),* 483-490.

The researchers calculated the odds of being obese after controlling for age and survey period using data from 1999-2010; Table 3 presents the odds ratios. The odds of

being obese were higher for non-Hispanic black boys and girls and Mexican American boys and girls compared to both non-Hispanic white boys and girls.

Table 3

Odds of Childhood Obesity in 1999-2010

	Odds ratio[a]	
	Boys	Girls
Non-Hispanic white	1.00 (reference)	1.00 (reference)
Non-Hispanic black	1.27 (1.09-1.48)	1.99 (1.69-2.35)
Mexican American	1.81 (1.56-2.09)	1.47 (1.23-1.76)

[a]The odds ratios are based on logistic regression of obesity.
Note: Adapted from Ogden, C.L., Carroll, M.D., Kit, B.K., and Flegal, K.M. (2012). Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. *JAMA, 307(5),* 483-490.

Socioeconomic Status Disparities

Differences in childhood obesity prevalence have been seen between groups that vary by socioeconomic status (SES). Indicators of SES that are used in research include family income, parental education, parental occupation, residential neighborhood, or a composite of these measures (Shrewbury & Wardle, 2008). In school-based research, SES can be challenging to obtain at the individual level because of privacy and confidentiality concerns. An alternative to gathering family income data is to use the proxy measure of eligibility for free or reduced school meals (Baxter, Royer, Hardin, Guinn, & Devlin, 2011). The National School Lunch Program (NSLP) is a federally-funded meal program providing nutritionally balanced meals. Children in families living at ≤ 130% of poverty level qualify for free lunches. Children from families living between 130 and 185% of poverty level are eligible for reduced price meals, not to exceed 40 cents (United States Department of Agriculture, 2012).

In 2008, Shrewsbury and Wardle conducted a systematic review of cross-sectional studies of SES and adiposity in children 5-18 years of age conducted between 1990 and 2005. The studies were from western countries deemed to have high income; he definition used for high income was a gross national income per capita > $10,066 in US dollars. Countries represented in the studies included United Kingdom, Germany, United States, Australia, Italy, France, Netherlands, Belgium, Canada, Republic of Ireland, Spain, Sweden, and Switzerland. To be included, studies must have at least 1 measure of household or neighborhood level SES; these measures could include parental education, parental occupation, family income, home postcode, or a composite measure of indicators.

Forty-five studies were included in the review. Socioeconomic status was inversely associated with childhood obesity in 19 (42%) studies; inverse associations were defined as: the highest prevalence of obesity occurring in the lowest SES group, followed by the middle SES group, and the lowest prevalence in the highest SES group. In 12 (27%) studies, no statistically significant association between SES and childhood obesity was observed. The remaining 14 (31%) studies found a mixture of no association and inverse associations across subgroups (i.e. highest prevalence in lowest SES group, followed by lowest SES group, then the middle SES group).

The authors (Shrewsbury & Wardle, 2008) identified a pattern of inverse association between SES and obesity among western developed countries, although children among all SES groups are vulnerable. Recommendations were made for population-level strategies to prevent obesity in children with special efforts targeting lower SES groups.

Singh and Kogan (2010) examined data from 1976-2008 NHANES and 2003 and 2007 NSCH for differences in obesity prevalence among socioeconomic groups. In 2007, the prevalence of obesity among children living below poverty level was 27.4%, which was 2.7 times greater than the prevalence of obesity (10.0%) of children in families with incomes exceeding 400% of the poverty level. Obesity and overweight prevalence rose significantly among children in the lowest SES groups from 2003 to 2007 while the prevalence among children in the highest groups declined.

A query of the 2007 and 2010-2011 NSCH data showed that the prevalence of childhood obesity decreased in the U.S. and in Alabama as household income increased. The NSCH defines household income categorically using percentage of federal poverty level (FPL); the income quartiles are 0-99% FPL, 100-199% FPL, 200-399% FPL, and ≥ 400% FPL. Table 4 shows that from 2007 to 2010-2011 childhood obesity prevalence decreased in all 4 categories nationwide. In Alabama decreases were noted in the 100-199% FPL and ≥400% FPL while increased childhood obesity rates were seen in the 0-99% FPL and 200-399% FPL categories.

Table 4

Obesity Rates in Children 10-17 Years of Age in the US and in Alabama Based on Household % of Federal Poverty Level (FPL)

	United States		Alabama	
	2007	2010-2011	2007	2010-2011
0-99% FPL	27.2%	26.6%	21.2%	24.7%
100-199% FPL	20.9%	19.1%	22.3%	21.2%
200-399% FPL	14.9%	13.5%	15.5%	20.1%
≥400% FPL	9.8%	9.0%	14.9%	9.1%

Note: Adapted from National Survey of Children's Health. NSCH 2007. NSCH 2010-2011 Data query from the Child and Adolescent Health Measurement Initiative, Data Resource Center for Child and Adolescent Health website. Retrieved May 15, 2013 from www.childhealthdata.org

Geographical Disparities

Rates of childhood obesity vary by setting. Children residing in rural settings are more often obese (Davis, Bennett, Befort, & Nollen, 2011; Joens-Matre, Welk, Calabro, Russell, Nicklay, & Hensley, 2008). Similarly, as seen in Table 5, data from the 2007 National Survey of Children's Health indicate higher obesity rate for children from rural Alabama communities, when compared to peers living in other rural areas of the nation and Alabama cities (National Survey of Children's Health, 2007a). Among children in urban settings, 15.6% of children in Alabama were obese compared to 16.1% nationwide.

Table 5

Obesity Rates in Children 10-17 Years of Age in the US and Alabama in 2007 by Urban/Rural Locality

	United States	Alabama
Overall	16.4%	17.9%
	By Residence	
Urban	16.1%	15.6%
Rural	17.7%	23.3%

Note. Adapted from 2007 National Survey of Children's Health. National Survey of Children's Health. NSCH 2007. Child and Adolescent Health Measurement Initiative, Data Resource Center for Child and Adolescent Health website. Retrieved March 30, 2011 from www.nschdata.org.

Geiger and colleagues (2009) examined weight status of Birmingham area children using data collected from 15,560 kindergarten through fifth grade children who participated in a mobile health education program. Sixteen percent of the children were classified as overweight, and another 16% met the criteria for obese. The majority of the data (65%) were obtained from white students, and one-third of the participants were black students. Among white students, 15% were overweight and 13% were obese. In contrast, 18% of black students were overweight and 21% were obese.

Singh, Kogan, and van Dyke (2008) examined state and regional differences in childhood obesity among states and regions in the US using data from the 2003 NSCH of children 10-17 years of age. Data was reported according to nine geographical census regions, including New England, Mid Atlantic, East North-central, West North-central, South Atlantic, East South-central, West South-central, Mountain, and Pacific.

The primary covariate of interest was the state and census region of the child. In addition to the geographical variables, individual variables were also used as covariates: age, gender, race/ethnicity, composition of household, metropolitan/non-metropolitan residence, primary language spoken at home, parental education, household poverty threshold, social capital, perceived neighborhood safety, amount of television viewing, recreational computer use, physical activity, and sports participation.

The researchers examined variation of childhood obesity among geographic regions as a first step to understand the extent of disparities. Prevalence of childhood obesity was calculated for all 50 states, the District of Columbia, and the nine census regions. Multivariate logistic regression models were used to obtain relative odds and adjusted prevalence of childhood obesity after controlling for chosen socio-demographic behavioral factors. Stratified multivariate logistic models were used to explore region-specific interactions.

Childhood obesity prevalence ranged from a low of 8.5% in Utah to a high of 22.8% in the District of Columbia. After adjusting for age and gender differences, children in most states had significantly higher odds of being obese than their peers in Utah. Children in Alabama were among those that had significantly higher odds ($p < .05$) of being obese with an adjusted odds ratio of 1.55 (95% CI = 1.06, 2.26).

A comparison of the nine census regions showed that the Mountain region (Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, and Nevada) had a significantly lower prevalence of childhood obesity than the other eight census regions. Children in seven census regions had significantly ($p < .05$) higher odds of being obese. The highest adjusted odds ratio of 1.52 was seen in the West South-central region (Arkansas, Louisiana, Oklahoma, and Texas). Alabama is in the East South-central region along with Kentucky, Tennessee, and Mississippi, with an adjusted odds ratio of 1.46 for childhood obesity prevalence.

Research on School-Based Obesity Prevention Interventions

In his sentinel publication, *the Surgeon General's call to action to prevent and decrease overweight and obesity* (2001b), Dr. David Satcher identified five key areas for impacting weight status in the US including communities and families, schools, healthcare, worksites, and media. Although schools alone cannot turn the tide of childhood obesity, it seems improbable that this epidemic can be stopped without the involvement of schools. School programs that are well-designed and well-executed are successful in promoting physical activity, healthy eating habits, and limiting television viewing (CDC, 1996; CDC, 1997; Gortmaker et al., 1999a). Evidence also supports a relationship between healthy eating habits, physical activity, and academic performance (Kleinman, Hall, Green, Korzec-Ramirez, Patton, Pagano, & Murphy, 2002; Sallis, McKenzie, Kology, Lewis, Marshall, & Rosengard, 1999; Shepard, 1997). Evans, Finkelstein, Kamerow, and Renaud (2005) reported that parents perceive the school as a key player in the fight against childhood obesity. Schools were named more frequently

than health care providers and the government as "having a lot of responsibility" for reducing childhood obesity.

Systematic Reviews and Meta-Analyses

The scholarly literature (the Cochrane Library, Campbell Collaboration Library, 3ie Library, PubMed and PsychInfo database) was searched using the terms "childhood," "obesity," "school," and "intervention" separately and in combination to retrieve reviews and meta-analyses of school-based intervention programs to reduce determinants of childhood obesity. In addition, articles recommended by other researchers were considered. Systematic reviews and meta-analyses were included if published in English since 2000 and if the research article contains review of only school-based interventions. Four systematic reviews and four meta-analyses are included in this paper.

Systematic Reviews

Brown and Summerbell, 2009. In their 2009 review, Brown and Summerbell studied the effectiveness of school-based interventions that focused on the improvement of dietary and physical activity behaviors. A secondary objective was to identify outcome impacting characteristics such as demographic traits of study participants, process indicators, contextual factors that contributed to the implementation of the intervention, and maintenance of short-term changes.

The authors employed the search strategy used for the National Institute for Health and Clinical Excellence (NICE) obesity guidance, which is explained in *Obesity: The Prevention, Identification, Assessment and Management of Overweight and Obesity in Adults and Children* (2006). The search identified school-based obesity prevention studies providing details regarding the intervention, researchers, setting, and follow-up.

Only studies that reported a weight outcome were considered for the review. Researchers measured body weight as an outcome or change measure reporting an absolute value at baseline and follow-up. Weight status was measured as total body weight, body mass index (BMI), BMI Z-score, body fat percentage, skin-fold thickness, and percentage of overweight. Using MEDLINE and EMBASE, the authors identified 38 appropriate studies that were published between 1993 and 2007.

Study designs included in the review were randomized controlled trials (RCTs) or controlled clinical trials (CCTs) of a lifestyle intervention delivered in a school setting, and lasting a minimum of 12 weeks. Study populations were school children 5-18 years of age. Studies that recruited participants based on weight status were not included, nor were studies that intervened with children having chronic health issues or eating disorders.

A lifestyle intervention was defined as one that included healthy eating, increased physical activity, decreased sedentary behaviors, behavioral therapy, social support, and nutrition and physical activity education. For comparison, studies were classified with primary focus on diet, physical activity, or both diet and physical activity. Of the studies reviewed, 3 (8%) were diet only, 15 (39%) were physical activity only and 20 (53%) combined diet and physical activity.

Of the diet-only studies, only one of three showed any significant difference in BMI scores between intervention and control. Five of the 15 (33%) physical activity-only studies demonstrated a significant difference, whereas nine of the 20 (45%) combined diet and physical activity programs revealed a difference between intervention and control students.

Four (11%) of the total studies reviewed produced inconsistent effects on BMI by gender for children 10-14 years of age. In two of the combined diet and physical activity interventions, significant improvements in BMI were noted for boys, but not for girls; in two other combined diet and physical activity programs, BMI improvement was seen for girls but not boys.

Insufficient power reduced effectiveness of the evaluation for several studies attempting to discern differences between intervention and control groups. Only 10 of the 38 studies reviewed (26%), had sufficient power to detect differences between intervention and control groups. In 21 studies (55%), power was not reported; 3 studies (8%) were pilot programs and the remaining 4 studies (11%) had limited size, which precluded detection of differences between control and intervention groups.

Additionally, the authors noted that interventions may have been inadequate in length or intensity to produce a desired change in body weight or BMI. In eight studies (21%) the intervention was completed and follow-up data was collected within four months. It is possible that even if the programs are effective in producing changes in physical activity, sedentary behaviors, and dietary intake, this period of time may be insufficient to produce significant changes in weight status.

The authors concluded that although the findings were inconsistent, combined diet and physical activity interventions may be useful in preventing children from becoming overweight or obese in the long-term.

Kropski, Keckley, and Jensen, 2008. This systematic review evaluated school-based obesity prevention studies published since 1990 including experimental or quasi-experimental designs, curricular or environmental prevention programs. To be eligible

for inclusion, studies must have included an evaluation six months or longer after baseline, must have used an outcome measure of weight status, and must have been conducted with children of normal weight status as well as overweight or obese children. Studies were identified using PubMed, Biological Abstracts, and Education Abstracts.

The authors used a methodological grading system developed by the GRADE working group (Atkins et al., 2005). A baseline grade of 1-4 was assigned to each study based on research design. Randomized control trials were assigned a value of 4, quasi-experimental trails received a value of 3, observational studies were designated a value of 2 and all other studies received a value of 1. From this baseline the grade was adjusted by characteristics that weakened or strengthened the evidence; a higher grade indicated that a study was methodologically stronger. One point was subtracted from the baseline score due to serious design limitation, some uncertainty of directness (such as questionable validity of instruments and techniques), sparse data, high probability of reporting bias, uncertainty of external validity, and internal inconsistency Two points were subtracted in cases with very serious design limitations and serious uncertainty of directness. One point was added to baseline scores when there was a strong association without likely confounders, consistent and direct evidence, and all likely confounders would have diminished effect size. Each study was independently rated by two reviewers, who considered study design and methodology: means of randomization, randomization concealment, study power, cluster number and size, differences in baseline covariates, adjustment for baseline covariates, blinding of data collectors to intervention status, attrition, subjective measures, validity of measures, intention to treat protocol, unit of analysis, subgroup analysis, treatment effect, and external validity.

Fourteen studies met the criteria to be included in the review. Eleven of the studies (79%) included both a nutrition and physical activity component; 2 studies (14%) used physical activity-only interventions, and 1 study (7%) reported a nutrition-only intervention. Only 1 study was identified as a grade 4; grade 3 was assigned to 10 studies, and the remaining studies were considered weak (grade 2).

The nutrition-only study aimed at reducing the consumption of carbonated beverages among British children ages 7-11 years. A significant reduction (0.7 drinks/3 days) of carbonated beverages was observed. BMI outcomes were not reported in the review.

Two physical activity interventions were compared with usual physical activity curriculum. One study of 8- to 12-year old children in California (grade 2) showed a significant improvement in moderate-to-vigorous physical activity during PE, although no effect was seen regarding overweight. In Thailand a grade 3 study with kindergarten children resulted in a significant reduction in odds ratio for increased BMI among girls

Eleven studies used both nutrition and physical activity components in the interventions. A grade 4 study set in Boston middle schools found a significant reduction in percentage of overweight girls and an adjusted odds ratio for overweight of 0.47. The effect was reported to be mediated by a decrease in television viewing by girls. A grade 3 study conducted with Native American children produced no difference in overweight between intervention and control groups.

The Child and Adolescent Trial for Cardiovascular Health (CATCH) program was used for two studies. In a large grade 3 randomized controlled trial (RCT), improvements were seen among intervention students (increased moderate-to-vigorous

physical activity and decreased dietary fat); however, there was no effect on overweight outcomes seen. A grade 2 quasi-experimental effectiveness trial was set in a predominately Mexican-American community in Texas. The prevalence of overweight decreased by 11% among girls and 8% among boys.

A grade 3 RCT featured an environmental intervention with middle school children. In boys, a significant reduction of BMI (0.64kg/m^2) resulted, along with a significant increase in moderate-to-vigorous physical activity. No effects were noted among girls.

In the United Kingdom (UK), 2 RCTs resulted in significant increases in consumption of fruits and/or vegetables among children ages 5-11 years, although no significant effects for overweight were observed. A grade 2 quasi-experimental study in Nebraska with 7-to10-year-old students did not show an effect for overweight; however, a significant increase in physical activity was reported.

Researchers of a grade 2 study among German children 5- to 7-years of age reported significant reductions in triceps skinfold thickness at one-year follow-up. Four-year follow-up data reported significant relative reduction in prevalence of obesity among intervention girls only.

A quasi-experimental grade 2 study conducted in Chile with 8- to14-year-old students led to significant reductions in BMI (0.3 kg/m^2) and BMI Z-score (0.1 unit) among boys only. A grade 2 study set in Australia with children ages 10-12 years reported significant differences in triceps skinfold measures at follow-up assessment for boys and girls.

The authors reported difficulty drawing conclusions about the effectiveness of school-based obesity prevention programs. Of the 14 studies reviewed, only 4 (29%) were grade 3 or grade 4 quality. Thirteen studies (93%) were inadequately powered to detect changes in BMI, triceps skinfold measures, or overweight prevalence; this indicates that a Type II error cannot be excluded. Only three studies (21%) were conducted with participants representative of the demographics of the population of American school students.

Differences were noted in gender response to interventions; 2 studies found significant effects only for girls while 2 other studies saw significant effects only for boys. The authors point out that interventions targeting younger children ($\leq$ 7 years) were not as effective as those aimed at older children ($\geq$ 8 years), suggesting that future programs be directed at the older age group.

Li, Li, Baur, and Huxley, 2008. Li and colleagues conducted a systematic review of school-based intervention studies among Chinese children and adolescents for the prevention or reduction of excess weight. Studies published between 1990 and 2006 were identified using the China Journal Full Text Database of the China Knowledge Infrastructure and Wanfang DATA databases as well as Medline and Meditext. To be eligible for review, studies had to report on the effectiveness of a lifestyle behavioral intervention in population-based samples of children and adolescents in schools or kindergartens in Mainland China. Programs were considered effective if the outcome was significantly different between intervention and control groups ($p < 0.05$). Studies varied in both intervention and outcomes which prevented the use of a meta-analysis; a qualitative assessment was conducted as an alternative.

Studies were reviewed for quality using a modified version of the Effective Public Health Practice Project Quality Assessment Tool, as found in Appendix A (Thomas, Fitzpatrick-Lewis, & Muresan, 2008). Evaluation of studies included review of selection bias, allocation bias, control for confounding, blinding, data collection methods, loss to follow-up, statistical analysis and intervention integrity. Each evaluation section was assigned a rating of strong (value of 2), moderate (value of 1) or weak (value of 0). The scores for each section were added together to create an overall score of study quality**;** scores could range from a low of 0 to a high of 16. Overall scores were then classified into four categories: strong (13-16 points), moderate (9-12 points), average (5-8 points) and poor (0-4 points).

A total of 22 studies were identified for inclusion in the review. Study population ages ranged from 3-19 years, and length of intervention ranged from 10 weeks to 3 years (median and mode intervention length: 1 year). Sixteen of the studies (73%) targeted overweight or obese children. The authors noted that criteria for the definitions of overweight and obesity varied among studies; definitions that were used included World Health Organization (WHO) weight-for-height cut-offs, WHO BMI cut-offs (World Health Organization, 2010), Chinese weight-for-height criteria, Chinese BMI cut-offs (Group of China Obesity Task Force, 2004) and Japanese BMI cut-offs (Japan Society for the Study of Obesity, 2004). Two studies did not identify the definitions used for overweight and obesity.

The types of interventions varied among the 22 studies. Four interventions (18%) focused on health education, 2 studies (9%) included health education and physical activity, 7 studies (32%) combined health education, physical activity, and dietary

components, 6 interventions (27%) combined physical activity and dietary modification; the remaining 3 studies (14%) used physical activity interventions.

Among study outcomes were changes in prevalence of overweight and obesity, weight, skinfold thickness, BMI Z-score, biochemical markers, knowledge, and behavior. A significant decrease ($p < 0.05$) in body adiposity was reported in 18 of the studies (82%).

A power or sample size calculation was reported for only 1 of the studies (5%), and none of the studies included process evaluation. After using the Effective Public Health Practice Project Quality Assessment Tool (Effective Public Health Practice Project, 2009), none of the studies had a strong rating. Nine studies (41%) were assessed as moderate, 7 (32%) were rated as average, and the final 6 studies (27%) were deemed to be of poor quality.

None of the studies reported that informed consent was obtained from participants. Likewise, no study noted that an ethical review was conducted prior to the study.

The authors suggest using caution when interpreting findings from the review because most of the studies had weak methodology. Many of the studies failed to report the number of students, schools or school districts initially invited to participate, raising concerns about participant selection and recruitment bias.

In some studies, overweight and obese children participated in additional education lessons and physical activity. The authors note that this form of discrimination may predispose children to low self-esteem and other undesirable psychological

conditions. School-based obesity prevention programs should be designed in a way that benefits all students regardless of weight status.

The authors concluded their review by suggesting that future research include strategies that incorporate health and nutrition educational components within the school curriculum or promoting environmental modification to support healthy lifestyle habits.

Shaya, Flores, Gbarayor, and Wang, 2008. The authors of this systematic review searched PubMed and OVID databases for school-based obesity interventions. Inclusion criteria required that studies be obesity-related interventions targeting participants 7-19 years old, use pre- and post- anthropometric measures of weight status (i.e., BMI, skinfold measures, etc.), and be housed in school settings.

The literature search yielded a total of 51 studies. These studies varied by intervention type and duration. Fifteen studies (29%) used existing or modified physical activity programs or an in-school physical education class. Health and fitness educational models, dietary regimens, or physical activity behavior modification strategies were featured in 17 studies (33%). The final 19 studies (37%) incorporated combinations of physical activity programs, health/fitness educational models, and/or dietary/nutritional regimens.

The length of intervention studies spanned from 4 weeks to 8 years. Ten programs (20%) were conducted in less than 12 weeks; 18 studies (35%) were 12 weeks to 1 year duration. Twenty programs (40%) lasted more than one year. Duration data was not available for the remaining 3 studies.

Weight status outcome measures included in this systematic review included BMI, triceps and subscapular skinfold measurements, body fat percentage, ponderosity

indices, and waist-to-hip ratio. Other physiological variables reported in some of the studies were blood lipids, fasting insulin levels, blood glucose concentration and, systolic and diastolic blood pressure. Measures of fitness included flexibility tests (sit and reach), aerobic capacity (VO_2 Max), endurance (shuttle runs, mile run), and muscle strength (standing broad jump, abdominals). Quantitative variables including frequencies of fruit intake, vegetable consumption, and television viewing, as well as frequency and intensity of physical activity were identified in some studies.

The authors reported that 40 of the 51 studies (78%) demonstrated statistically significant results in some or all of the quantitative measures from baseline to follow up. Thirteen of the fifteen studies (87%) using exclusively physical activity interventions reported statistically significant findings in anthropometric or obesity-related measures.

Twelve of the sixteen studies (75%) using programs aimed at modifying diet, physical activity, and health/fitness knowledge showed positive results in clinical measures. Among the 20 studies that combined physical activity interventions with nutrition, health, and fitness components, 15 studies (75%) identified positive results.

Although the authors identified that 78% of the studies reviewed reported statistically significant results, it is not clear what percentage of studies demonstrated statistically significant improvements for the weight status outcome measure. In addition, these authors report studies using ponderosity indices and waist-to-hip ratio as outcome measures in unidentified study populations; the use of these outcome measures was not noted in previous systematic reviews. In addition, it is unclear whether intervention type or duration impacted weight status of participants. Although the

authors identify the diversity among school-based obesity prevention interventions, it is difficult to draw conclusions about their efficacy.

Summary of systematic reviews. The four systematic reviews included 113 different research articles. The 23 studies used in the Li and colleagues (2008) article were not included in the other 3 systematic reviews. Li and colleagues noted significant methodological and ethical concerns in these studies that may have prevented the articles from being published in international journals. Of the remaining 90 studies, some overlap was found among the systematic reviews. Appendix B identifies the studies used in each of the systematic reviews. Four studies were included in three of the systematic reviews (Brown & Summerbell, 2008, Kropski et al., 2008; Shaya et al., 2008). Thirteen studies were included in two of the systematic reviews. Seventy-three studies were only used in a single systematic review.

Results of the four systematic reviews appear inconclusive. The authors of three reviews (Brown & Summerbell, 2008, Kropski et al., 2008, Li et al., 2008) indicate that the significant methodological concerns and the lack of adequately powered studies make it difficult to draw conclusions. Shaya and colleagues (2008) report the majority of studies in their review produced statistically significant changes in some or all of the quantitative measures; however, it is not known how many studies positively affected weight status. Brown and Summerbell (2008), as well as Kropski and colleagues (2008) noted gender differences in weight-related outcomes. Kropski and colleagues (2008) reported that interventions with children 8 years of age or older appear more effective than those with younger children. Brown and Summerbell (2008) suggested that

although findings were inconsistent, school-based obesity prevention interventions may be useful in preventing overweight and obesity in the long-term.

Meta-Analyses

Reviews of four meta-analyses published in 2008 or 2009 are found below. A total of 59 studies were considered in the four reviews.

Cook-Cottone, Casey, Feeley, and Baran, 2009. A meta-analysis of school-based childhood obesity prevention studies published between January 1997 and July 2008 was conducted by Cook-Cottone and colleagues (2009). Studies were identified through database searches in PsychINFO, Medline, Cumulative Index to Nursing and Allied Health Literature (CINAHL®), Academic Search Premier, and the Cochrane Database of Systematic Reviews. Each study included in data analysis featured an objective anthropometric outcome measure, such as BMI, skinfold thickness, waist or hip circumference, or body fat percentage estimate. After reviewing potential studies for consideration, 66 comparisons from 40 published studies were utilized. Some studies had multiple levels of intervention allowing for more comparisons.

BMI and BMI Z-score were the primary outcome measures of weight status. Additionally, rates of overweight and obesity and triceps skinfold measurements were reported.

The effect size *r* was used in the meta-analysis. An *r* value of .06 signifies a 6% positive change in study outcomes in the intervention verses the control group. Fixed-effects analyses were performed, and study weights were proportional to sample size and standard error. Therefore, larger studies essentially counted more than small studies in

the aggregate effect size calculation. Results revealed a significant relationship for 40 of the 66 comparisons, r = .05 (95% CI, .04, .06, N = 31,059, p<.001).

Universal interventions, those offered to all students regardless of weight status, (k = 37, r = .07; p < .001) were significantly more effective than selected interventions in which participants were chosen based on weight status. Success of interventions differed by age of participants with interventions aimed at elementary school children significantly more effective (k = 41, r = .06; p < .001) than those targeting middle school children (k = 20, r = .02; p < .05). A significant effect was not seen in programs for high school students (k = 5, r = .04). Interventions including both boys and girls were observed to have a significant and positive effect (k = 62, r = .05; p < .001), but there was no significant effect seen in the four programs targeting only girls.

Significant and positive effects were seen in interventions aimed at Asian students (k = 5, r = .30; p < .001) and predominately white students (k = 47, r = .01; p < .05). One intervention with Native American children had a small, positive effect (r = .01). No significant effects were found in interventions targeting African-American (k = 7, r = .03) or Hispanic students (k = 6, r = .01).

The intensity of interventions did not moderate effects. Both low intensity programs (k = 28, r = .05), those implemented 1-2 times per week, and high intensity programs (k = 23, r = .07), those conducted 3-5 times per week, showed positive and significant effects (p < .001). Programs with a short duration, 12 weeks or less, were observed to have significant and negative effects (k = 11, r = -.04; p < .05). Positive and significant effects were reported for low/moderate, moderate, and long programs (p < .001). Low/moderate length programs were defined as 13-27 weeks (k = 16, r = .04);

moderate length programs lasted 28-32 weeks (k = 23, r = .07), and the duration of long programs exceeded 32 weeks (k = 16, r = .05).

The use of psycho-educational content was found to have a significant overall effect (k= 57, r = .05; p < .001). For purposes of the meta-analysis, psycho-educational content was defined as the presentation of information on topics such as diet, exercise, and nutritional education. Interestingly, interventions that encouraged healthy eating were significantly more effective (k = 28, r = .13; p < .001) than those implementing system-wide nutritional changes (k = 15, r = -.03, p = .001) or no nutritional change at all (k = 23, r = .05; p < .001).

Concerning activity components of interventions, there were no significant effects see in interventions that included fitness enhancement (k = 49, r = .03), i.e. a focus on strength, endurance, and self-care. Conversely, positive and significant effects were seen among interventions that included increased or enhanced physical activity alone (k = 49, r = .04; p < .001) and programs with no physical activity component (k = 8, r = .09; p < .001). Programs that aimed to decrease sedentary behaviors were significantly more effective (k = 17, r = .15; p < .001) than programs that did not (k = 17, r = .03; p < .05).

The authors conclude by pointing out that only 38% of the studies yielded significant weight gain prevention effects. Due to the significant variance among outcomes, it appears that student and intervention characteristics are associated with improved efficacy. The authors suggest that obesity prevention in schools may be enhanced by integrating specific features that best meet the needs of the student population.

Kanekar and Sharma, 2008. Kanekar and Sharma performed a meta-analysis on school-based childhood obesity interventions conducted in the United States and the United Kingdom between 2000 and 2007. Database searches within MEDLINE and CINAHL were used to locate studies. In addition, three review articles cited in these reviews were then retrieved. To be included, studies must have been published English and in a peer-reviewed journal between 2000 and 2007. Further, research had to be conducted within school settings in the US or UK with a general population of children (as opposed to obese children only); BMI must be included as an outcome measure.

Five studies met the criteria to be included in the meta-analysis. Follow-up assessments were completed between 3 months and 12 months. The studies were reviewed for quality by considering population sample size, study design, intervention type and duration, post-intervention follow-up period, and outcome measures; however, no formal evaluation was completed to determine the quality. The authors reported that quality appeared good based on duration of intervention, presence of control groups, and targeting school children in similar age ranges (average of 8-11 years of age).

When the study results were pooled, the authors found no difference in aggregate BMI change scores between intervention and control groups. In their discussion for future research, the authors suggest conducting meta-analyses of additional outcome measures of school-based childhood obesity intervention, such as physical activity behaviors, sedentary behaviors, fruit and vegetable intake and soft-drink intake. These factors may be more likely to be altered than BMI.

Gonzalez-Suarez, Worley, Grimmer-Somers, and Dones, 2009. Gonzalez and colleagues (2009) performed a meta-analysis to evaluate the effectiveness of school-based programs for preventing and managing childhood obesity. Studies included in the review were published in English between 1995 and 2007. The authors utilized a two-step search strategy. The first step involved searching for studies in the following databases: Ovid (MEDLINE, PsychINFO, EMBASE, EBM Reviews), Cochrane Library, CINAHL, Current Contents, BioMed Central, AustHealth, SCOPUS, TRIP (Turning Research into Practice), Science Direct, Health Source: Nursing/Academic Edition, AMED, PubMed, and Academic Elite. The keywords used for searches were: childhood obesity, adolescent obesity, youth obesity, child obesity (all for concept 1); and treatment, management, prevention, or program (as concept 2). Relevant articles were then retrieved. Next, a search was conducted of the reference lists and bibliographies of all articles that had been retrieved in step one.

Studies considered in the meta-analysis enrolled school children of any nationality, at normal weight or above normal weight, in preadolescent or adolescent stages of life, and with weight status classified by an age- and gender-specific cutoff point system created by the International Obesity Task Force (or by specific norms developed by a country). Inclusion criteria specified that the programs must have sought to increase physical activity, improve dietary behaviors, alter poor activity or diet behaviors, or a combination of the approaches. The meta-analysis included only studies that had high methodological appraisal scores, as determined by the JBI (Joanna Briggs Institute) Critical Appraisal of Evidence Effectiveness tool located in Appendix E (2004).

A total of 19 papers were included in the meta-analysis. In general, researchers attempted to reduce overweight by increasing physical activity, decreasing sedentary activities, and decreasing intake of foods that are high in fat and sugar. Classroom lessons included concepts such as limiting intake of high fat and high sugar foods, increasing intake of fruits and vegetables, and the importance of physical activity. The length of physical education classes was expanded permitting more time to be spent in moderate-to-vigorous activities. Outcome measures such as BMI, waist girth, body fat percentage, and triceps skinfolds were used to assess weight status.

A meta-analysis of data derived from different interventions revealed that the intervention showed a protective effect for being overweight or obese with an odds ratio (OR) of 0.74 (95%, CI=0.60, 0.92). Program duration was observed to have an effect in this meta-analysis. Participants in programs that lasted 1-2 years and those that lasted over two years were seen to have a lower likelihood of being overweight or obese, with ORs of 0.81 (95% CI=0.68, 0.92) and 0.59 (95% CI=0.37, 0.94) respectively, when compared with programs lasting less than six months. Although this meta-analysis suggests that school-based interventions can reduce the prevalence of overweight and obesity, BMI was not shown to be reduced in the treatment group when compared to controls.

Gonzalez-Suarez and colleagues noted that numerous factors may influence the effectiveness of school-based interventions such as duration of program, type of program used, age of participants, involvement of parents, school culture and environment and compliance with intervention.

Katz, O'Connell, Njike, Yeh, and Nawaz, 2008. Katz and colleagues conducted a systematic review and meta-analysis of school-based obesity prevention studies occurring between 1966 and October 2004. Studies were identified using MEDLINE, HealthStar, PsychInfo, EMBASE, OVID, and CINAHL. To be included in the meta-analysis, studies had to: be published in English, be aimed at children 3-18 years of age in a school setting, report a commonly used weight outcome such as BMI or body weight, include a control group measurement, and follow participants for at least six months from the beginning of the intervention.

Data were retrieved from each article using the standardized protocol developed by the Centers for Disease Control (Zaza et al., 2000). The CDC data abstraction form contains three sections: classification information, descriptive information, and study quality. Studies of poor quality were excluded from the analysis.

Nineteen studies described in 21 papers were used for the meta-analysis. Although data from two studies were published twice, they were only included once in the analysis. There were no studies published prior to 1980 that met the quality criteria to be included. Fourteen studies (74%) were randomized controlled trials and the remaining five studies (26%) were non-randomized controlled trials. Thirteen of the studies (68%) were universal obesity prevention interventions whereas six studies (32%) were treatment programs. Thirteen studies (68%) were conducted in elementary schools, three studies (16%) targeted middle school students, and the remaining three studies (16%) took place in high schools. Nine studies (47%) were conducted overseas, and 10 studies (53%) took place in the US. One study (5%) was aimed at girls only.

Of the 19 studies included in the systematic review, eight studies (42%) contained adequate data to be included in the meta-analysis. Of the eight studies used in the meta-analysis, the types of interventions included:

- Physical activity only;
- Nutrition only;
- Nutrition, physical activity, and environment;
- Nutrition, physical activity, and parental involvement;
- Nutrition, physical activity, and family involvement;
- Nutrition, physical activity, specialized behavioral intervention, and family component;
- Nutrition, physical activity, and specialized behavioral intervention (body image); and
- Behavioral only: reduction of sedentary behaviors, such as television and video viewing.

Statistical analysis was conducted using the standardized mean differences (SMD). The use of SMD was selected because the different studies analyzed weight loss in different ways such as BMI and body weight. Results of the different studies could be pooled by using SMD. A positive SMD represented weight gain and a negative SMD signified weight loss.

The physical activity-only intervention did not demonstrate significant results. In contrast, the combined interventions, the nutrition-only intervention and the behavioral intervention to reduce sedentary activities all showed significant and positive results ($p < 0.05$). The pooled effects of the combination interventions, nutrition intervention, and

behavioral intervention were: SMD = -0.29, 95% CI = -0.63 to -0.06. Observing the interventions based on content, the nutrition only intervention (SMD = -0.39, 95% CI = -0.56 to -0.23), the behavioral intervention (SMD = -0.35, 95% CI = -0.63 to -0.06), and the combination interventions (SMD = -0.29, 95% CI = -0.45 to -0.14) were seen to have similar findings. Interventions that contained a parent or family component demonstrated improvements in weight status among participants (SMD = -0.20, 95% CI = -0.41 to 0.00).

The authors concluded that combination intervention programs can produce significant and positive weight changes among school age children. The physical activity only intervention did not demonstrate significant improvements, whereas the nutrition only and the behavior only interventions did show significant and positive results. The authors cautioned drawing conclusions from the results of these studies, because only one study per intervention type was included in the meta-analysis.

Summary of Meta-Analyses. A total of 59 articles were included for the four meta-analyses; some of the articles were used in more than one analysis. Eleven studies (19%) appeared in two or three meta-analyses; there were no studies that were represented in all four analyses. Three studies (5%) were used in three meta-analyses, and 8 studies (13%) were utilized in two meta-analyses. The remaining 48 articles were used in only one analysis.

The results from the 4 meta-analyses were mixed. Kanekar and colleagues (2009) observed no significant results in BMI among the 5 school-based childhood obesity interventions considered in their analysis. Both Gonzalez-Suarez and colleagues (2009) and Katz and colleagues (2008) reported that interventions appear to be effective in

reducing the prevalence of overweight and obesity. Only 38% of the studies used by Cook-Cottone and colleagues (2009) produced significant findings in weight gain prevention.

Characteristics of interventions that produced greater effects included:

- Targeted elementary school students,
- Were aimed at Asian or predominately white students,
- Lasted longer than 12 weeks,
- Contained nutrition education and behavioral components,
- Included increased or enhanced physical activity, and
- Addressed the reduction of sedentary behaviors.

Expert Recommendations for School-Based Obesity Prevention Interventions

Findings in the systematic reviews and meta-analyses were similar to those reported by the World Health Organization (2009) and the Academy of Nutrition and Dietetics, formerly known as the American Dietetic Association (2006b). As part of a larger report on diet and physical activity, the WHO (2009) reviewed interventions in school settings to determine the effectiveness of programs. The authors identified characteristics of effective and moderately effective interventions. Effective interventions were defined as: based on a formative assessment, having a robust experimental design or sufficient sample size, and demonstrating significant effects on outcome measures. The effective interventions typically met all or most of the planned objectives and showed promise for future feasibility and sustainability. School-based obesity prevention interventions that were considered effective were identified as:

High-intensity programs focusing on diet and/or physical activity. These programs featured comprehensive, multi-component aspects of a focused approach along with supportive activities in the curriculum, and a formative assessment addressing the needs of the schools and cultural contexts.

Moderately effective interventions differed from high-intensity programs and lacked one or more of the components identified for effective interventions. The moderately effective interventions were adequately robust to be considered for future applications. Characteristics of interventions that were reported to be moderately effective included:

- A curriculum on diet and/or physical activity taught by trained teachers
- A supportive school environment
- A physical activity program
- A parental or family component and
- The availability of healthy food options through the school food services such as cafeteria and vending machines.

The findings by the WHO were similar to those reported by Gonzalez-Suarez and colleagues (2009) and Katz and colleagues (2009).

In 2006, the Academy of Nutrition and Dietetics published a position paper on various interventions to prevent childhood overweight and obesity including school-based interventions. The Academy recommended the use of school-based obesity prevention interventions that include:

- Multiple components, such as physical activity and nutrition components
- Behavioral counseling, such as the use of goal setting using role models, vicarious learning and changing of social norms

- Nutrition education
- Physical activity education
- Physical activity environmental changes, such as increasing the amount of time spent in physical activities, or restructuring physical education classes to allow more time for moderate-to-vigorous physical activity
- Parent or family involvement,
- Reducing sedentary behaviors, and
- Provided to elementary and secondary grade school children.

Like the WHO article, the recommendations presented by the Academy of Nutrition and Dietetics are in agreement with the results reported by Gonzalez-Suarez and colleagues (2009) and Katz and colleagues (2008).

Researchers and professional organizations identified earlier have recommended school-based obesity prevention interventions that contain both physical activity and nutrition components. In the systematic reviews and meta-analyses examined, very little information was provided about the specific physical activity and nutrition content of the interventions. The exceptions were studies by Robinson (1999) that focused on reducing sedentary behaviors such as television and video viewing and James, Thomas, Cavan, and Kerr (2004) that targeted reducing carbonated beverages.

Interventions seeking to alter the weight status in children and adolescents should address behaviors that are associated with overweight and obesity. In 2007, the American Academy of Pediatrics Expert Committee (Barlow and the Expert Committee) identified target behaviors that may prevent excessive weight gain.

Those behaviors that relate to school age children include:

- Limiting intake of sugar-sweetened beverages
- Consuming the recommended quantities of fruits and vegetables
- Limiting screen time (television, videos, etc.) to no more than 2 hours per day and removing televisions and other screens from children's primary sleeping area
- Eating breakfast daily
- Restricting eating out at restaurants, particularly fast food restaurants
- Encouraging family meals whereby children and parents eat together
- Limiting portion size
- Eating a diet rich in calcium
- Consuming a diet high in fiber
- Eating a diet with a balance energy from fat, carbohydrates, and protein appropriate for age
- Promoting moderate-to-vigorous physical activity at least 60 minutes per day; and
- Eating a limited amount of energy-dense foods.

Although the overall results for school-based childhood obesity interventions are inconclusive, using multi-component interventions that target the behaviors identified above in a program with a parental or family component appears to increase the likelihood of success.

Healthy Eating Active Living (HEAL)

Healthy Eating Active Living (HEAL) is a community-initiated (Non-profit 501c3) physical education (PE) curriculum that seeks to improve fitness and increase knowledge and behaviors regarding physical activity, nutrition, and disease prevention

(including obesity prevention) among fifth-grade children in Alabama. Championed and spearheaded by Christy Swaid, HEAL was formalized with the addition of Drs. Bonnie Spear, Donna Dunaway, and Donna Hester, experts in nutrition and physical activity (B. Spear, personal communication, October 21, 2011).

In the spring of 2007, the first HEAL curriculum was developmentally tested in PE classes with fifth grade students in two Birmingham area schools. A cornerstone of the HEAL program is the use of technology, in the form of heart rate monitors, during PE classes. Heart rate monitors offer a number of advantages in PE. Heart rate monitors, such as those used in the HEAL program, offer a signal of the relative stress placed on the heart during physical activity (Armstrong, 1998). The monitors offer children a means of identifying a target heart rate to maintain during physical activity. Students are then able to compare the effects of different physical activities on the heart rate, and observe progress in fitness. Teachers utilize heart rate monitors to improve instruction, to increase knowledge about physical health of the heart, and to plan for safe physical activity among students (Tipton & Sander, 2004). In addition to the instruction given during the class period, teachers also utilized nutrition handouts, calendars, and homeplays (i.e. homework) to increase knowledge and motivation among students and parents. The curriculum activities were implemented and altered based on perceived effectiveness and feasibility. Feedback provided by teachers, students, and volunteers guided the further refinement of the curriculum (D. Hester, personal communication, October 31, 2011).

During the summer of 2007, four additional schools were recruited to participate in a HEAL pilot study. The addition of these schools to the initial two HEAL schools

provided a diverse groups of students in regards to race/ethnicity and SES. Two PE teachers from each participating school were trained during a two-day workshop. The first day of the workshop provided a program overview and sample activities. Throughout the second day, teachers developed action plans indicating how the 20-week HEAL curriculum would be implemented within the school (D. Hester, personal communication, October 31, 2011).

The pilot implementation of the HEAL curriculum began in the 6 previously mentioned schools in the fall of 2007. At the onset of the school year, baseline measurements were taken from 610 fifth grade students (B. Spear, personal communication, October 21, 2011). Physical measures used were items from the FITNESSGRAM®, developed by The Cooper Institute in Dallas, Texas. A fitness assessment, the FITNESSGRAM® uses criterion-referenced standards, called Healthy Fitness Zones, to determine fitness levels of students (Welk & Meredith, 2008).

HEAL staff members provided support by visiting the schools, on average one time per week during the first three months. Observation checklists and process evaluation tools were used to determine whether HEAL standards were being followed. During the second three-month period, support was given to these pilot schools largely through phone calls and emails (B. Spear, personal communication, October 21, 2011).

Pilot data showed that 42% of participants at baseline had BMI-for-age percentiles at or above the 85^{th} percentile, meeting the criteria for overweight or obese (Samford University, unpublished data). Follow-up data collected approximately five months later showed a significant change in BMI rank and PACER scores as 1.4% moved from the overweight to healthy weight category and 0.9% shifted from obese to

overweight status. Additionally significant improvement was observed among all nutrition behaviors – decreased intake of fast foods, soft drinks and sweetened sports drinks, and increased intake of fruits, vegetables, and milk (Samford University, unpublished data).

HEAL program staff were pleased with the impact of the curriculum, specifically since it appears to allow every child to succeed. In addition, modifications have been made for children with special needs, the curriculum materials are translated in Spanish, activities are designed in such a manner that they can accommodate various school environments, and the technology allows teachers to identify students who are over- or under-performing (B. Spear, personal communication, October 21, 2011). The flexibility of the program for the PE teacher has been noted as a key advantage. Unique challenges exist among individual schools such as equipment, facilities, class time, class size, and the number of instructors (D. Hester, personal communication, October 31, 2011).

Since the 2007 pilot, HEAL has modified the curriculum based on recommendations by teachers and students. Although the curriculum was initially designed to be taught over the entire school year, feedback from teachers indicated that the time frame was not realistic. The curriculum was condensed to 20 weeks and is divided into three phases of eight, seven and five weeks respectively. Each phase reinforces and builds on the previous segment. Teachers also requested fewer handouts and homeplays in the curriculum. In order to accommodate this request, the HEAL team replaced some of the messages previously used in handouts with posters that could be hung in the schools. This maintained a visual message related to the curriculum while cutting down on the amount of paper the teacher needed to handle. Another advancement

to the handouts that correspond with the HEAL curriculum has been the creation of bound student workbooks instead of individual handouts (D. Hester, personal communication, October 31, 2011).

During the 2009-2010 school year, changes were made with the heart rate monitors and with physical assessments. The initial heart rate monitors used by HEAL were a chest-strap type of monitor; however, because these monitors were problematic at some schools, a switch was made to a watch-only heart rate monitor. During the same school year, the physical measurements of push up and curl up (for measuring muscular strength and muscular endurance) and the back-saver sit and reach (for measuring flexibility) were eliminated from the assessment. At this time the measurements that are completed include the PACER (for measuring aerobic capacity), heights and weights (for calculation of BMI), and the knowledge and behavior questionnaire (D. Hester, personal communication, October 31, 2011).

At this time, HEAL is being used in 21 elementary schools across the state of Alabama. The design of the HEAL curriculum was developed to ensure a strong scientific base. Table 6 compares the recommendations of the American Academy of Pediatric Expert Committee on Prevention, Assessment, and Treatment of Child and Adolescent Overweight and Obesity to the components of the HEAL curriculum. Both the components of the program and the target behaviors identified in the education address national recommendations for obesity prevention as well as recommendations for school based intervention (B. Spear, personal communication, October 21, 2011).

Table 6

Comparison of Recommendations and Composition of the HEAL Curriculum

Basis for Recommendation	Recommendation	Included in HEAL?
Consistent Evidence	Limit consumption of sugar-sweetened beverages	Yes
	Limit television and screen time to no more than two hours per day	Yes
	Remove television and computer screens from children's primary sleeping areas	Yes
	Eat breakfast daily	Yes
	Limit eating at restaurants, particularly fast food restaurants	Yes
	Eat family meals	Yes
	Limit portion size	Yes
Mixed evidence	Consume diet with recommended quantities of fruits and vegetables	Yes
Data Analysis & Expertise of Committee	Eat a diet rich in calcium	Yes
	Eat a diet rich in fiber	Yes
	Eat a diet with balanced macronutrients (e.g., carbohydrate, protein, and fat)	Yes
	Initiate and maintain breastfeeding	N/A
	Participate in 60 minutes of moderate to vigorous physical activity daily	Yes
	Limit intake of energy-dense foods	Yes

Note: Adapted from Davis, M., Gance-Cleveland, B., Hassink, S., Johnson, R., Paradis, G. & Resnicow, K. (2007). Recommendations for prevention of childhood obesity. *Pediatrics, 120(Supplement 4),* S229-S253.

In 2006, the Academy of Nutrition and Dietetics published its position paper entitled, *Position of the American Dietetic Association: Individual-, Family-, School-, and Community-Based Interventions for Pediatric Overweight*. The position paper was the compilation of results found from a systematic review of evidence-based analysis of pediatric obesity in the literature.

Recommendations for primary prevention intervention in schools included the following elements as part of a multi-component program:

- Behavioral counseling
- Nutrition education
- Physical activity education
- Physical activity environment changes
- Parental/family involvement
- Reduction of TV/video watching
- And use in elementary and secondary schools.

Although the literature contained limited evidence to support customary recommendations, it was believed that media influences and food environment changes were areas that hold promise for future research. There was a lack of evidence to base any recommendations for delivery of program, length of program, homework, reading, and computer usage (American Dietetic Association, 2006b). Table 7 presents a comparison of American Dietetic Association, now the Academy of Nutrition and Dietetics, recommendations for school-based obesity prevention interventions and the composition of the HEAL curriculum.

Table 7

Comparison of Recommendations for School-Based Prevention Interventions and Composition of the HEAL Curriculum

Basis for Recommendation	Recommendation	Included in HEAL?
Recommended type of program	Multi-component	Yes
Recommended as part of a multi-component program	Behavioral counseling	No
	Nutrition education	Yes
	Physical activity education	Yes
	Physical activity environmental changes	Yes
	Parent/family involvement	Yes
	Sedentary behaviors (decrease TV/video watching)	Yes
	Grade level (recommended in secondary and elementary schools)	Yes, used in elementary schools
Limited evidence to support routine recommendation	Media influences	No
	Food environment change	No
Lack of evidence to base any recommendation	Homework/reading/computer use	Yes (i.e. Homeplays)
	Length of program	20-week curriculum
	Delivery of program	Delivered by school PE teachers who have received HEAL training

Note: Adapted from American Dietetic Association. (2006). Position of the American Dietetic Association: individual-, family-, school-, and community-based interventions for pediatric overweight. *Journal of the Academy of Nutrition and Dietetics, 106(6),* 925-945.

Health Behavior Theories

Health behavior theories and models function to explain behavior and to provide a framework for developing effective methods of influencing behaviors. DiClemente, Crosby, and Kegler (2002) suggest that the term *theory*, "is used to represent an interrelated set of propositions that serve to explain health behavior or provide a

systematic method of guiding health promotion practice." A model is a synthesis of concepts from any number of theories and used collectively. Models are useful for comprehending a problem in a particular setting (Glanz, Rimer, & Lewis, 2002). Commonly used health behavior theories and models include Health Belief Model, Social Cognitive Theory, Theory of Planned Behavior, the Transtheoretical Model/Stages of Change, Social Support and Social Networks, Social Marketing, Diffusion of Innovations, Stress and Coping, and Ecological Models/Social Ecology (Glanz et al., 2008).

Ecological models consider the interrelations between people and their environments. Sallis, Owen, and Fisher (2008) proposed these four key principles of ecological models of health behavior:

1. There are multiple influences on specific health behaviors, including factors at the intrapersonal, interpersonal, organizational, community, and public policy levels.
2. Influences on behaviors interact across these different levels.
3. Ecological models should be behavior-specific, identifying the most relevant potential influences at each level.
4. Multi-level interventions should be most effective in changing behavior. (pp. 888-889).

The value of ecological models is seen in authoritative documents such as the Institute of Medicine (IOM) reports on health behaviors (Institute of Medicine, 2001), childhood obesity prevention (Koplan, Liverman, & Kraak, 2005), and the World Health

Organization's (WHO) strategy for diet, physical activity, and obesity (World Health Organization, 2004).

Social Ecological Model

The Social Ecological Model provides a means of exploring behavior related to both individual and environmental determinants (McLeroy, Bibeau, Steckler, & Glanz, 1988). This model is rooted in the work of Urie Brofenbrenner (1979) in which behavior is both affected by and affects multiple levels of influence. In the Social Ecological Model, the individual holds the core position and encircling layers identify larger groups that influence a person. The model identifies five layers of influence including individual, interpersonal, organizational (or institutional), community, and public policy.

On the individual (or intrapersonal) level, influences include factors such as knowledge, attitude, behaviors, perceived barriers, age, gender, preferences, and self-efficacy. Individual level behaviors that have been recommended to promote healthy weight status among children include limiting intake of sugar-sweetened beverages, consuming the recommended amounts of fruits and vegetables, limiting screen time to no more than two hours per day, eating breakfast daily, limiting portion size, eating a diet rich in calcium and fiber, limiting energy-dense foods, and engaging in at least 60 minutes of moderate to vigorous activity daily (Barlow & Expert Committee, 2007). Interventions at this level seek to change characteristics of the individual through means such as educational programs, support groups, and mass media (Sisson et al., 2009).

The interpersonal level identifies that family, friends, and social networks can impact behavior, which may result from social support and identity (McLeroy et al., 1988). Target behaviors for maintaining a healthy weight status at the interpersonal

level include limiting eating out at restaurants, especially fast food restaurants, and encouraging family meals (Barlow & Expert Committee, 2007). Interventions at this level could target parents, encouraging them to serve as role models by engaging in healthy eating behaviors, being physically active, providing healthy food choices, restricting access to sugar-sweetened beverages, placing limits on screen time, limiting the frequency of eating out, and ensuring family meals.

Organizational factors include rules and policies that affect the individual by preventing or promoting a behavior. Because individuals spend 1/3-1/2 of their lives in organizational settings, this level of influence can have a significant impact (McLeroy et al., 1988). Social norms and values, either positive or negative, are strongly transmitted at this level (Van Maanen & Barley, 1985). School-based and worksite-based interventions address the organizational level. Public schools, serving 89% of the nation's children and adolescents, have an unparalleled opportunity to influence the knowledge, attitudes, and behaviors of students (Collins, 2009). Based on the prospects of reaching young people, schools were challenged to actively participate in the prevention and treatment of childhood obesity by the Surgeon General in 2001 (Thomas, 2004).

On the community level, behaviors can be influenced by the social norms that exist among groups of individuals and organizations. McLeroy et al. (1998) define the community level in three distinct ways:

- Mediating groups (such as neighborhoods, voluntary organizations, and churches) to which individuals belong,
- Relationships among organizations with an area

- Identifiable in terms of geographical or political terms.

Interventions at the community level could include the creation of a walking club in a neighborhood, the introduction of a local farmer's market, and supporting funding for a new recreational facility. Churches have become instrumental partners in health promotion. Churches are stable institutions that can offer resources such as buildings, meeting rooms and kitchens, a venue for recruitment of participants, pastor encouragement, and church-sponsored education seminars or events (Campbell, Hudson, Resnicow, Blakeney, Paxton, & Baskin, 2007).

At the public policy level, authoritative decisions made by governing bodies can regulate certain health behaviors. National media campaigns (i.e. Let's Move!) and wellness legislation are examples. As part of the Child Nutrition and WIC Reauthorization Act of 2004, local education agencies that participate in programs authorized by the Richard B. Russell National School Lunch Act or the Child Nutrition Act of 1966 were required to develop wellness policies (Public Law 108-265). Interventions at this level could address any local, state, or national policies or laws that impact physical activity and eating behaviors.

This ecological perspective emphasizes the interaction and interdependence of factors within and across all levels. Programs that address multiple layers of influence are more likely to produce behavior change (Gregson et al., 2001).

An impressive example of a multi-level approach was described by Heinrich, Aki, Hansen-Smith, Fenton, and Maddock (2011) in the passage of Safe Route to School and Complete Streets policies in Hawaii. Potentially unlikely collaborators came together to address the need to improve the built environment for active transportation and to limit

the number of pedestrian and cycling fatalities. In a 22-month period, individuals representing all of the Social Ecological Level spheres of influence participated including community members and developers (individual-level); advocacy groups (interpersonal level); transportation, planning, and education professionals (organizational level); county council members and planning commission members (community level); and state legislators and top department officials (policy level). In June 2009, the actions of this group culminated with new policies (Act 54 – Safe Routes to School and Act 100 – Complete Streets) being signed into law.

HEAL Curriculum and SEM

HEAL was developed as a disease prevention physical activity curriculum that promotes improved physical activity and dietary behaviors. The HEAL curriculum instructs students on healthy habits along with strategies for incorporating those into daily life. On the individual level, the HEAL curriculum addresses nutrition knowledge, nutrition behavior, physical activity knowledge, physical activity behavior, health attitudes, and self-efficacy. (B. Spear, personal communication, October 21, 2011).

The interpersonal level is addressed through HEAL by the inclusion of a parent component. Handouts and Homeplays (i.e., homework) provide parents with guidance for establishing healthy behaviors within the home. Interpersonal level factors include the availability of healthy and unhealthy foods, opportunities to engage in physical activity, frequency of family meals, and frequency of meals eaten out at restaurants (B. Spear, personal communication, October 21, 2011).

The use of the HEAL curriculum influences the institutional, community, and policy levels. Other factors within these spheres of influence that may impact weight status include the length of PE period, the location of the school (urban, suburban, or

rural), and SES of the school. (B. Spear, personal communication, October 21, 2011). Table 8 identifies levels of influence that may affect or be affected by the HEAL curriculum.

Table 8

SEM Levels of Influence That May Affect or Be Affected by HEAL

Level	Characteristic
Individual	Gender
	Race/Ethnicity
	Health status weight status (BMI-for-age)
	Cardiovascular fitness
	Knowledge - physical activity, healthy eating behaviors, sedentary activity
	Attitudes –physical activity, healthy eating behaviors, sedentary activities
	Behaviors – dietary habits, physical activity, and sedentary activities
	Self-efficacy – physical activity, healthy eating behaviors, sedentary activities
	Skill – physical activity, use of heart rate monitor
	Receptiveness to HEAL curriculum
Interpersonal	Family demographics
	Availability of healthy foods and physical activity opportunities
	Limited availability to unhealthy foods
	Provision of family meal time
	Familial norms concerning health behaviors
Organizational	District and local school requirements for PE classes
	Local school administration support for PE program
	Length of PE period
	Size of class
	Number of PE teachers and aides
	School wellness policies
	Size of school
	Location of school (urban, suburban, or rural)
	School type (private or public)
Community	Cultural norms related to health behaviors
	School socio-economic status
Policy	State of Alabama PE course of study

Note: Adapted from McLeroy, K., Bibeau, D., Steckler, A. & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly, 15(4),* 351-377.

Life Course Perspective

The Life Course perspective identifies childhood as a significant period in establishing lifelong health because health is produced through the span of one's life (Barker, 2002), and suggests today's experiences and exposures determine tomorrow's health (Fine, Kotelchuck, Addess, & Pies, 2009). In addition, this approach identifies health and disease patterns, particularly health disparities, across the population (U.S. Department of Health and Human Services, 2010c). As a way of structuring the impact of children's health on disease, disability, and death among adults, Life Course perspective distinguishes how long-term health is influenced by collective risk and protective factors that are present during critical and sensitive periods (Elder, 1998).

Some core terms used in the Life Course Perspective are cohort, transition, trajectory, and turning point. A cohort is a group of people who were born in the same time period and who undergo societal changes in the same order and at the same age. A transition is a change in role or status that is a marked departure from previous roles; for instance, a child's role may change from being an only child to being a brother or sister. Trajectories provide a long-term view of patterns of stability and change over one's life. A turning point is a time when a significant change occurs in trajectory of life; the ramifications of a turning point become more significant as time passes (Hutchison, 2010). Interventions that reduce health risks and increase protective factors have the potential to change the health trajectory of individuals and groups (Pies, 2011).

It is known that children who are obese are more likely to be obese as adults (Whitaker, Wright, Pepe, Seidel, & Dietz, 1997) and obesity in adulthood confers risks for chronic illnesses such as diabetes mellitus, cardiovascular disease, and some cancers (National Institutes of Health, 1998). Obesity in children may also lead to elevated lipid

levels and increased blood pressure (Freedman, Mei, Srinivasan, Berenson, and Dietz, 2007). As a result, children who are obese are already on a trajectory that reduces health and wellbeing for future years. Because of the potential health risks in adulthood, the prevention of childhood obesity has been proposed as a mean of decelerating the prevalence of obesity-related diseases in adulthood (Labarthe, Eissa, & Varas, 1991). In this study, the participating children are considered a cohort; some of these children received the HEAL intervention, and others did not. The goal of the HEAL intervention is to provide a turning point in the lives of children which improves the health trajectory for their lives.

CHAPTER THREE

METHODOLOGY

This study included a quantitative analysis of secondary data collected during the 2010-2011 school year from students in HEAL intervention and comparison schools. This project was assigned protocol number X120725003 and was approved on December 10, 2013 by the UAB Institutional Review Board (Appendix G).

The study was a secondary data analysis to determine the effectiveness of a school-based intervention. Numeric data was available for pre- and post- measures of BMI z-scores, PACER scores, and survey items from up to 700 students. Using SPSS 19.0, data was screened and frequencies obtained. Descriptive statistics, missing data, and normality were identified. A 2-by-2 repeated measures ANOVA analyses was performed to determine whether differences exist between the two groups on two occasions (pre and post). These results were compared to results in the literature, and findings will be shared with program staff and teacher participants.

Research Design

This secondary data analysis was conducted using quantitative data gathered in 2010-2011 using a pretest-posttest design. This design is widely used in behavioral research to examine change that results from an experimental condition (Dimitrov & Rumrill, 2003). During the pretest phase both the experimental group and the comparison group were assessed. The experimental group received the intervention while the comparison group did not receive this intervention. Following the completion

of the intervention, posttest assessments were obtained from both experimental and comparison groups (Fisher & Foreit, 2002). This simple design allows the researcher to determine whether the intervention had a causal effect (Robson, Shannon, Boldenhar, & Hale, 2001). This experimental design controls for type 1 error which is the rejection of a null hypothesis when the hypothesis is indeed true (Cottrell & McKenzie, 2005).

This secondary analysis used data from groups that were matched based on school characteristics of racial/ethnic composition and socioeconomic status. Therefore, the study was a quasi-experimental design with non-equivalent controls.

The non-equivalent controls used in quasi-experimental designs protect from threats to internal validity such as history, maturation, testing, and instrumentation. The history effect identifies an event that occurs between pretest and posttest that could impact the dependent variable (Creswell, 2012). Maturation addresses changes that occur in participants due to the passage of time, such as changes in growth and knowledge (Fraenkel & Wallen, 2003). The threat of testing suggests that by participating in a pretest, subjects may learn how to perform better on a posttest, while instrumentation may present a threat when study instruments do not accurately measure what they are supposed to measure (Neutens & Rubinson, 2002).

A comparison of intervention and comparison group pretests evaluated similarities between the two groups. When groups are similar at pretest, then a stronger case can be made for attributing posttest differences to the intervention (Fisher & Foreit, 2002). Using repeated measures ANOVA for statistical analysis, any changes occurring between pretest and posttest were revealed along with differences existing pretest and posttest.

Disadvantages to the pretest-posttest design include time commitment, attrition, and possible pretest-intervention interaction. Collection of data both before and after an intervention requires a substantial amount of time and resources. Attrition, or the loss of participants between pretest and posttest, may occur. Attrition in this study may have occurred due to children moving from one school to another. The HEAL post quantitative data collection took place around the time of devastating tornadoes in Alabama. This data collection could have been impacted by the destruction of schools, school closings, and relocation of students. HEAL intervention and comparison schools were not damaged by the tornadoes and HEAL PE teachers indicated that students did not move as a result. The HEAL data collection team had to reschedule data collection dates for several schools to accommodate the day of the storms and school closings. Finally, a pretest-intervention interaction could have sensitized the students to the data being collected (Cottrell & McKenzie, 2005).

Controls for History and Maturation

History and maturation are potential threats the internal validity of a research project. As noted earlier, history relates to the events that occur between pretest and posttest (Creswell, 2012) and maturation addresses changes that occur in subjects due to the lapse of time between measurements (Fraenkel & Wallen, 2003). For both history and maturation threats, the use of matched comparison groups increases internal validity (Robson, Shannon, Goldehar, & Hale, 2001) as the events (other than the intervention) occurring between pretest and posttest should produce similar effects between experimental and comparison groups. Children in this study were 10 to 11 years of age at the time of data collection; this age range represents the ending of middle childhood and

the beginning of early adolescence. Middle childhood, 5 to 10 years of age, is a time when improvements in strength and coordination occur along with a child's competence in his or her physical abilities. During this time logical thinking replaces magical thinking and self-efficacy develops. As children move into early adolescence, 11 to 14 years of age, physical development brings about increases in height and strength (Hagan, Shaw & Duncan, 2008). The presence of comparison schools were a great asset when considering the maturation effect because students in both groups were maturing simultaneously.

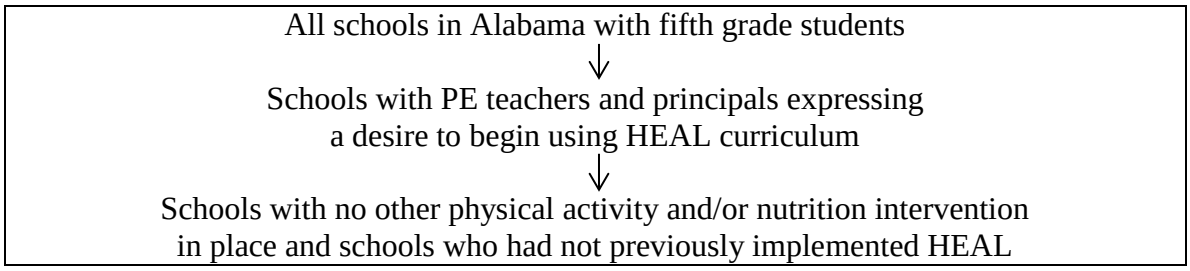
Matching of HEAL Intervention and Comparison Groups

The schools were be the unit of analysis for matching and assignment to groups. It was not be feasible to assign individuals to different conditions within the same grade level and school. In order to address issues that could weaken internal validity, additional schools were utilized as comparison schools, or delayed intervention schools; they began receiving the program during the 2011-2012 school year.

A series of steps was taken by the HEAL team to identify schools as indicated in Figure 1. Initially all schools in Alabama with fifth grade students were eligible for consideration. Next, the pool of schools was limited to those schools with PE teacher(s) and a principal expressing a desire to begin using the HEAL curriculum; schools that previously used the curriculum were not eligible for the study. The interested teachers and principals were questioned to identify the presence of any additional health program taking place at the school. Schools were excluded when another health program was being conducted since it would be difficult to measure the effects of a single health education program of interest.

Figure 1

Selection of Schools in HEAL Study



From the schools that met the criteria, the HEAL team matched intervention and comparison schools using racial/ethnic composition of the school and SES as described below. Six Alabama comparison schools that had expressed interest in the HEAL program were matched with the nine intervention schools. Race/ethnicity and SES were chosen to match schools, because both demographic characteristics have been correlated with the prevalence of childhood obesity (Freedman, Ogden, Flegal, Khan, Serdula, & Dietz, 2007; Singh, Kogan, van Dyck, & Siahpush, 2008; Ogden et al., 2010; Singh, Siahpush, & Kogan, 2010). Subsidized meal eligibility has been identified as a socioeconomic status index (Caprio, Daniels, Drewnowski, Kaufman, Palinkas, Rosenbloom, & Schwimmer, 2008); the percentage of students eligible for free or reduced meals was used as the school socioeconomic status variable. Although matching of both racial/ethnic composition and SES was desired, it was not always feasible. If schools matched on only one primary characteristic, they were required to match on two secondary characteristics as well. Additionally, there could be no more than one category difference between intervention and comparison schools. Secondary characteristics included rural or urban locality, school district, or area within the state. Five intervention schools were matched with five comparison schools and the remaining comparison

school was matched with a grouping of four intervention schools. Data from one intervention school and one comparison school are not available; therefore, data from a total of eight intervention schools and five comparison schools are available for analysis.

School Matches

Definitions related to socioeconomic and racial/ethnic variables mirrored those used by the U.S. Department of Education, National Center for Education Statistics. Schools were described as *High Minority, Medium Minority,* or *Low Minority* schools based on racial and ethnic composition. A High Minority school has greater than 50% minority students. Medium Minority schools are composed of 5% - 50% minority students, and Low Minority schools have less than 5% minority students (Aud, Hussar, Bianco, Frohlich, Kemp, Tahan, 2011). Poverty status of each school was distinguished by three categories. In *Low Poverty* schools, 25% or fewer students received free or reduced lunch. *Medium Poverty* schools provide free or reduced lunch to 26% - 75% of students, and in *High Poverty* schools, 76% or more of students are eligible for free or reduced lunch (Aud, Hussar, Johnson, Kena, Roth, Manning, Wang, & Zhang, 2012).

Shown within Table 9 is school information including students eligible for subsidized meals and student enrollment by race and ethnicity. The minority status and poverty status of students attending intervention and comparison schools are presented in Table 10.

In Pair (or Match) A, schools match as *Low Poverty*. Three of the intervention schools are *Medium Minority* while one intervention and the comparison school are *Low Minority*. The three *Medium Minority* intervention schools are small private schools in

Birmingham while the *Low Minority* intervention and comparison schools are public schools in Birmingham. Although three intervention schools in Pair A meet the definition for *Medium Minority*, it is noted that none of the schools have a minority student population above 12 %. Among secondary characteristics, all of these schools are considered urban/metro in the same city.

In Pair B the schools match for *Low Minority*. The intervention school is defined as *Low Poverty* whereas the comparison school meets the criteria for *Medium Poverty*. Although the poverty definitions differ, these schools differ in free and reduced lunch participation by only 8%; in the intervention school 21.7% of students receive free or reduced lunch while 29.7% of students in the comparison school receive free or reduced lunch. Both intervention and comparison schools in Pair B are located in North Alabama and are considered urban (United States Census Bureau, 2010) and metro (Washington, Wyoming, Alaska, Montana, and Idaho Rural Health Research Center, n.d.) areas.

Schools in Pair C match for both *Medium Minority* and *Medium Poverty*.

Pair D schools match on poverty status but differ in minority status; the intervention school is a *Medium Minority* school, and the comparison school has a *Low Minority* population. Additional similarities for Pair D have been identified; both public schools are in county school districts. Further, both schools are in areas that are considered rural (United States Census Bureau, 2010) and metro (Washington, Wyoming, Alaska, Montana, and Idaho Rural Health Research Center, n.d.) and are in northern Alabama.

Pair E intervention and comparison schools matched based on minority but poverty status differed. The intervention school is a *High Poverty* school but the

comparison school is a *Medium Poverty* school. Besides minority student status, Pair E schools are comparable due to location; both schools are in the same metropolitan city and the same school district.

Selection of Classes for Collection of Data

Once the schools were selected and assigned to either the intervention or the comparison group, a sample of classes was selected for data collection. Although the entire fifth grade at a school participated in the intervention, data were not collected on all fifth grade students at the intervention or comparison schools. Only a sample of students received the assessments. All students received the assessments in schools with 2 fifth grade classes. In schools with more than 2 fifth grade classes, a minimum of 40% of students received the assessments. The HEAL research team chose to gather assessments on a minimum of 40% of students to allow for adequate power in the study. The procedure used for selecting classes for data collection is shown in Appendix H.

Table 9

Demographic Data of HEAL Intervention and Comparison Schools

HEAL Pair	% of students receiving free or reduced lunch	School composition by race/ethnicity: % Hispanic	% Non-Hispanic, black	% Non-Hispanic, white	% Other race/ethnicity
Pair A					
1 – Intervention	0.0	<1	7	91	1
4 – Intervention	0.1	0	1	98	1
6 – Intervention	0.0	<1	9	88	3
9 – Intervention	0.0	4	4	91	5
10- Comparison	0.1	1	1	99	0
Pair B					
3 - Intervention	21.9	2	0	98	0
13 – Comparison	29.7	1	1	97	2
Pair C					
5 – Intervention	46.6	14	1	85	0
11 – Comparison	41.8	1	4	94	1
Pair D					
7 – Intervention	62.3	1	27	71	1
15 – Comparison	37.4	2	2	96	0
Pair E					
8 – Intervention	79.5	15	53	32	0
14 – Comparison	46.0	4	58	34	4

Free and reduced lunch information retrieved from http://www.alsde.edu/html/reports_menu.asp . Racial/ethnic composition of public schools retrieved from http://www.publicschoolreview.com/publix_schools/stateid/AL . Racial/ethnic composition of private schools retrieved from http://www.greatschools.org/alabama/

One additional pair of schools (school identification numbers 103 and 203) was included; however, data for those schools are not available.

Table 10

Minority and Poverty Status of HEAL Intervention and Comparison Schools

School	Minority status	Poverty status
Pair A		
1 – intervention	Medium minority	Low poverty
4 – intervention	Low minority	Low poverty
6 – intervention	Medium minority	Low poverty
9 – intervention	Medium minority	Low poverty
10 – comparison	Low minority	Low poverty
Pair B		
3 – intervention	Low minority	Low poverty
13 - comparison	Low minority	Medium poverty
Pair C		
5 – intervention	Medium minority	Medium poverty
11 – comparison	Medium minority	Medium poverty
Pair D		
7 – intervention	Medium minority	Medium poverty
15 – comparison	Low minority	Medium poverty
Pair E		
8 - intervention	High minority	High poverty
14 - comparison	High minority	Medium poverty

Note: Minority status defined as in Aud, S., Hussar, W., Bianco, K., Frohlich, L., Kemp, J., Tahan, K. (2011). *The condition of education 2011* (NCES 2011-033). U.S. Department of Education, National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.
Poverty status as defined in Aud, S., Hussar, W., Johnson, F., Kena, G., Roth, E., Manning, E., Wang, X., & Zhang, J. (2012). *The Condition of Education 2012* (NCES 2012-045). U.S. Department of Education, National Center for Education Statistics. Washington, DC. Retrieved June 24, 2012 from http://nces.ed.gov/pubsearch.

Timeline for Intervention and Comparison Schools

Table 11 presents the HEAL project timeline. During the months of September and October of 2010, pretest assessments were conducted in intervention and comparison schools. Following pretest assessments, the intervention schools used the HEAL curriculum in physical education classes from September 2010 to April 2011. During

that time, the comparison schools used their traditional methods of instruction compatible with state curricular frameworks. In April and May of 2011, posttest assessments were conducted in intervention and comparison schools. Beginning in September 2011, the comparison schools began a delayed intervention using the HEAL curriculum while the intervention schools continued using the HEAL curriculum.

Table 11

Timeline for Intervention and Comparison Schools

	September - October 2010	September 2010 – April 2011	April – May 2011	September 2011 - May 2012
Intervention schools				
Pretest assessments				
Intervention				
Posttest assessments				
Continued use of HEAL curriculum				
Comparison schools				
Pretest assessments				
Posttest assessments				
Delayed intervention				

Analysis

The independent variable considered was intervention status. Dependent variables included weight status, aerobic fitness, nutrition knowledge, physical activity knowledge, nutrition behavior, and physical activity behavior. The main analysis examined differences between groups from pretest to posttest. In addition, a description of differences in dependent variables when classified by gender, school minority status, and school poverty status will be completed.

Pretest and posttest variables were continuous (BMI Z-scores, PACER scores, knowledge scores, and behavior scores). Participant data was included if all components are available for analysis. A significance level of .05 was be used throughout the study.

The study was shaped by these proposed research and null hypotheses:

- Hypothesis 1

  $H_{1:}$ Weight status is more improved in the intervention group than the comparison group at posttest measurement as evidenced by lower BMI Z-scores.

  H_0: There is no significant difference in weight status between the intervention group and the comparison group at posttest measurement as evidenced by BMI Z-scores.

- Hypothesis 2

  H_2: Aerobic fitness is greater in the intervention group than the comparison group as evidenced by higher Progressive Aerobic Cardiovascular Endurance Run (PACER) scores in the intervention group at posttest measurement.

  H_0: There is no significant difference in aerobic fitness as evidenced by PACER scores between intervention and comparison groups at posttest measurement.

- Hypothesis 3

  H_3: Nutrition knowledge scores are higher in the intervention group than the comparison group at posttest measurement.

  H_0: There is no significant difference in nutrition knowledge scores between the intervention group and the comparison group at posttest measurement.

- Hypothesis 4

  H_4: Physical activity knowledge scores are higher in the intervention group than the comparison group at posttest measurement.

  H_0: There is no significant difference in physical activity knowledge scores between the intervention group and the comparison group at posttest measurement.

- Hypothesis 5

  H_5: Nutrition behavior scores are higher in the intervention group than the comparison group at posttest measurement.

  H_0: There is no significant difference in nutrition behavior scores between the intervention group and the comparison group at posttest measurement.

- Hypothesis 6

  $H_{6:}$ Physical activity behavior scores are higher in the intervention group than the comparison group at posttest measurement.

  H_0: There is no significant difference in physical activity behavior scores between the intervention group and the comparison group at posttest measurement.

Measurements Used for Analysis

In this secondary data analysis, data were available to consider weight status, aerobic fitness level, nutrition knowledge, physical activity knowledge, nutrition behavior, and physical activity behavior. Weight status was assessed using BMI, and aerobic fitness levels were identified using the PACER test. Nutrition knowledge, physical activity knowledge, and nutrition behavior scores are available from a HEAL survey completed by the students.

BMI Z-score

The BMI Z-scores, also known as BMI standard deviation scores, are a measure of relative weight which is adjusted for children's age and gender. The Z-score is determined using the following formula:

$$z = \frac{x - \mu}{\sigma}$$

where:

x is the score to be standardized;

μ is the mean of the population;

σ is the standard deviation of the population.

BMI Z-scores are calculated relative to an external reference (i.e. CDC reference data) corresponding to growth chart percentiles (Must & Anderson, 2006). A Z-score of 0 is equal to the 50th percentile, a Z-score of +1.00 is approximately equal to the 84th percentile, a Z-score of +2.00 is approximately equal to the 98th percentile, and a Z-score of +2.85 is greater than the 99th percentile (Lobstein, Baur, & Uauy, for the IASO International Obesity Task Force 2004). While BMI Z-scores and BMI percentiles are essentially equal, BMI Z-scores are more appropriate for statistical analysis when a continuous measure of relative weight is required, such as a change is weight status (Cole, Faith, Pietrobelli, & Heo, 2005; Inokuchi, Matsuo, Takayama, & Hasegawa, 2011). When reporting results, BMI Z-scores can be identified as percentiles to improve interpretation among readers (Must & Anderson, 2006).

To generate Z-scores, researchers can use tables or computer software. Appendices H and I contain excerpts from tables for determining Z-scores as

recommended by the CDC (n.d). To use a table, gender, exact age, and BMI of the participant must be known. Different tables exist for boys and girls. The Z-score is determined by identifying the point at which exact age and BMI intersect on the appropriate table; the Z-score is then found in the uppermost cell of that column. Table 12 presents select BMI Z-scores and corresponding BMI-for-age percentiles. In this secondary analysis, BMI-for-age was converted to BMI Z-scores using Epi Info, a program that can be downloaded from the CDC (CDC, 2011d).

Table 12

Select BMI Z-scores and Corresponding BMI-for-Age Percentiles

BMI Z-score	BMI-for-age percentile
-1.881	3rd
-1.645	5th
-1.282	10th
-0.674	25th
0.000	50th
0.674	75th
1.036	85th
1.282	90th
1.645	95th
1.881	97th

Note: Adapted from CDC, 2009a

Processes for BMI measurement in children. Several authors have identified challenges of measuring BMI in children, and other authors have suggested protocols for training data collectors. Calculation of BMI and BMI-for-age requires the collection of height and weight measurements. More reliable data is obtained through the use of trained data collectors as opposed to relying on self-report because these measures have a high subject acceptance (Lobstein et al., 2004). Data used in this study included measures

of heights and weights that were completed by HEAL team members who had been trained using the HEAL measurement protocol (See Appendix J).

Himes (2009) identified challenges in the measurement of BMI in children and provided suggestions for reducing errors when gathering height and weight measures and BMI calculations. The use of a mounted wall stadiometer or a portable stadiometer that allows the child to stand correctly with his or her back against a vertical surface is suggested (Gordon, Chumlea, & Roche, 1988). Weight measures should be taken using high-quality scales that offer maximum consistency. Both scales and stadiometers should be checked frequently to insure correct calibration (Himes, 2009). Due to the potential embarrassment to children (Zeman, Cassano, Perry-Parrish, & Stegall, 2006), having a private area for the collection of height and weight measures improves confidentiality and participant cooperation (Himes, 2009). HEAL data collectors used PE teachers' offices and supply closets to ensure privacy during data collection.

Himes (2009) recommends using protocols for measuring height and weight that resemble those used for the gathering of the CDC growth chart reference data which is found at the CDC National Health and Nutritional Examination (NHANES) website (www.cdc.gob/nchs/data/nhanes.bm.pdf). Data collectors should all be trained using the same methodology to improve consistency, and copies of the protocol should be available on site as a reminder for data collectors. To minimize variation, the use of as few data collectors as possible is desirable. The data collectors should each have a unique identification code (Himes, 2009). Table 13 presents recommendations by Himes (2009) compared to procedures used by HEAL data collectors.

Table 13

Data Collection and Management Practices for Reducing Errors for Height, Weight, and BMI

Recommendation	Completed by HEAL?
Equipment and space	
Choose appropriate equipment	Yes
Check and calibrate equipment regularly	Yes
Maintain extra batteries for scales	Yes
Provide a private area for child measurements, if possible	Yes
Measurement protocols	
Choose a protocol that matches that used in the growth charts	Yes
Have written copies of measurement protocols available for review	Yes
Train and standardize data collectors	Train: yes Standardize : no
Make sure data are recorded in appropriate units	Yes
Makes sure data are measured and recorded to the nearest unit specified in the protocol	Yes
Collect some replicate measurements for assessment of reliability, if feasible	No
Personnel	
Use as few observers as is feasible to take measurements, especially for research studies	Yes
Identify observers on data-collection forms or on data-entry programs	Yes
Data management	
Use as exact ages as possible	Yes
Have unique identifiers for children	Yes
Calculate BMI, percentiles, and z-scores by using tables or computer programs.	Yes

Note: Adapted from: Himes, J. (2009). Challenges of accurately measuring and using BMI and other indicators of obesity in children. *Pediatrics, 124*, S3-S22.

Progressive Aerobic Cardiovascular Endurance Run (PACER)

The PACER is a 20 meter shuttle run used to examine aerobic capacity. A recommended component of the FITNESSGRAM assessment battery (Meredith & Welk,

2004, Plowman, Sterling, Corbin, Meredith, Welk, & Morrow, 2006), the PACER was adapted from the 20 meter shuttle run published by Leger and Lambert (1982) and later revised (Leger, Mercier, Gadoury, & Lambert, 1988). In the multistage test, participants run back and forth over a 20 meter course in time to music played from a CD. The sound track contains beeps that indicate when a runner should be at the end of the course. Beginning with a slow pace, the pace increases with each additional minute; runners continue on the course until the pace can no longer be maintained. The more laps a participant is able to complete, the greater the aerobic capacity (Cureton & Plowman, 2008).

Validation studies in youth fitness frequently use VO_2max as a measure of cardiovascular fitness (Barnett, Chan, & Bruce, 1993; Cureton, Sloniger, O'Bannon, Black, & McCormack, 1995; Leger et al., 1988). VO_2 max represents the maximum amount of oxygen a person can use during intense or maximal exercise (The Cooper Institute, n.d.). Validation testing of the PACER test has been conducted using scores from the test (maximum running speed, number of levels finished, number of laps completed, or estimated VO_2) compared to VO_2 max measured using a treadmill-based protocol. In these studies moderate to high correlations (.514 - .90) have been observed (Armstrong, Williams, & Ringham, 1988; Barnett et al., 1993, Boreham, Paliczka, & Nichols, 1990; Leger et al., 1988) as presented in Table 14.

Table 14

Concurrent Validity of PACER Test in Children and Adolescents

	Sample	Validity coefficient
Armstrong et al., 1988	77 boys, 11-14 years	.54
Barnett et al., 1993	27 boys & 28 girls, 12-17 years	.74
Boreham et al., 1990	23 boys, 14-16 years	.64
	18 girls, 14-16 years	.90
	23 boys & 18 girls, 14-16 years	.87
Leger et al., 1988	188 boys & girls, 8-19 years	.71
Liu et al.,1992	22 boys, 12-15 years	.65
	26 girls, 12-15 years	.51
	48 boys & girls, 12-15 years	.69
Matsuzaka et al., 2004	62 boys & 70 girls, 8-17 years	.80
van Mechelen et al., 1986	41 M, 12-14 years	.68
	41 F, 12-14 years	.69
	82 M & F, 12-14 years	.76

The reliability of the PACER test has also been examined; reliability of a measure indicates the repeatability of test scores even when test environments may be different (e.g., a different day of the week or a different test administrator). Norm-referenced reliability studies using the PACER with children and adolescents have shown reliability coefficients above .64 (as shown in Table 15**).** Using norm-referenced context, consistency of scores is measured using intraclass correlation (Mahar & Rowe, 2008).

Table 15

Reliability Studies of PACER Test

Source	Sample	Reliability coefficient
Beets & Pitetti, 2006	123 boys , 13-18 years	.68
	62 girls, 13-18 years	.64
Dinschel, 1994	57 boys & 44 girls, 4^{th}-5^{th} grade	.84
Leger et al., 1988	139 boys & girls, 6-16 years	.89
Liu et al., 1992	20 boys and girls, 12-15 years	.93
Mahar et al., 1997	137 boys & 104 girls, 10-11 years	.90

HEAL Survey

A survey tool was developed to assess knowledge, attitudes, and behaviors of fifth grade students in Alabama participating in either intervention or comparison HEAL schools. The survey was designed as a pencil and paper tool used for both pre- and post-assessments in the PE classrooms. The goals of survey development were creating a tool that (a) includes appropriate questions to explore knowledge, attitudes, and behaviors related to physical activity and nutrition; (b) contains wording suitable for fifth grade students, and (c) could be completed by students in thirty minutes or less. The HEAL survey contains 14 nutrition knowledge questions, 3 physical activity knowledge questions, 5 dietary behavior questions, 7 physical activity behavior questions, 6 availability questions, 2 perceived value questions, 6 self-efficacy questions, and 3 physical activity preference questions. Not all questions were entered into the HEAL database. Questions that were entered include: 14 nutrition knowledge questions, 4 nutrition behavior questions, 3 physical activity knowledge questions, and 5 physical activity behavior questions, No psychometric property measurements were conducted beyond the development of the survey. The final version of the HEAL survey instrument in found in Appendix L.

Scoring of data

In this study, a comparison of mean BMI Z-scores was made to determine if a difference exists between intervention and comparison schools at pretest and posttest. In addition to the inferential analysis, the percentage of students in each weight category defined by CDC is presented in chapter 4. Differences by group in prevalence of overweight and obesity are also discussed.

A student's PACER score is the number of laps completed during testing. The mean PACER score for intervention and comparison schools was compared at pretest and posttest. Additionally the results from the PACER tests were compared to PACER performance ranges for health related fitness zones identified in the Alabama physical fitness assessment test administrator manual draft (Alabama Department of Education, 2011). The standards categorized PACER scores into categories of needs improvement, healthy, and high fitness zone. As shown in Table 16, the criteria for categories differ by gender and age.

Table 16

PACER Performance Ranges for Health-Related Fitness Zones

	BOYS		
	Needs Improvement	Healthy	High Fitness Zone
Age (in years)			
10	0-22 laps	23-61 laps	>61 laps
11	0-22 laps	23-61 laps	>61 laps
12	0-31 laps	32-72 laps	>72 laps
	GIRLS		
	Needs Improvement	Healthy	High Fitness Zone
Age (in years)			
10	0-6 laps	7-41 laps	>41 laps
11	0-14 laps	15-41 laps	>41 laps
12	0-14 laps	15-41 laps	>41 laps

Note: Adapted from Alabama Department of Education. (2011). Alabama physical fitness assessment test administrator manual, draft. Retrieved February 26, 2012 from: http://qualtitypeinalabama.pbworks.com/f/Alabama+Physical+Fitness+Assessment+(Draft).pdf

Fourteen nutrition knowledge questions were included on the HEAL survey. These questions, shown in Appendix M, were designed to have a single correct answer. For each knowledge question answered correctly, one point was assigned. Scores ranged from 0 (no knowledge) to 14 (high knowledge) points for nutrition knowledge questions.

Mean scores of intervention and control school were compared to determine whether differences exist between the two groups at pretest and posttest.

Three physical activity knowledge questions were used on the HEAL survey. Found in Appendix N, these questions had only one correct answer for each item; one point was assigned for each correct response. Physical activity knowledge scores ranged from 0 (no knowledge) – 3 (high knowledge) points, and mean physical activity knowledge scores of intervention and comparison schools were compared at pretest and posttest.

The HEAL survey included behavior questions addressing nutrition behaviors, physical activity behaviors, and physical inactivity behaviors. Each item response was assigned a point value. The least desirable behavior frequency (based on HEAL curriculum recommendations) received the lowest value and the highest value will be assigned to the most desirable behavior. Mean behavior scores were compared at pretest and posttest for intervention and comparison schools.

Four questions on nutrition behavior were found in the HEAL survey (see Appendix O). For each question the student was asked to identify how frequently he or she engaged in a specific dietary behavior. Scores for two questions ranged from 1-5 points, with the remaining two questions having a range of 1-4 points. Nutrition behavior scores ranged from 0 (low behavior) – 18 points (high behavior)

Physical activity and physical inactivity behavior questions are shown in Appendix P. Possible point values ranged from 0-15 points for these five questions.

For each set of summed questions, a Cronbach's alpha coefficient was used to estimate the internal consistency of items in the survey in order to gauge reliability

(Cronbach, 1951). A range of 0-1 is the normal range of a Cronbach's alpha; the closer the coefficient is to 1.0, the greater the internal consistency of items. In 2003, George and Mallery created suggested guidelines for Cronbach's alpha: >.9 = excellent, >.8 = good, > .7 = acceptable, >.6 = questionable, >.5 = poor, and <.5 = unacceptable. In this study, a Cronbach's alpha of .7 was used as recommended by Nunnally, 1978. In cases where the Cronbach's alpha is found to be lower than .7, questions from that set were analyzed individually.

Descriptive Statistics

For each set of scores (BMI Z-scores, PACER test, nutrition knowledge, physical activity knowledge, nutrition behavior, and physical activity behavior), descriptive statistics (means and standard deviations) were used to summarize characteristics of the sample. Descriptive statistics are presented by treatment group. Only cases with valid values were included for analysis. Knowledge and behavior scores were considered valid only when scores fall within possible point ranges.

Repeated Measures ANOVA

A two-way groups-by-tests repeated measures ANOVA was used to identify change occurring between pretest and posttest as well as differences between groups on each occasion. In repeated measures ANOVA, subject measures of a dependent variable are taken two or more times (Vogt, 1993). This design provides analysis of both a within-subjects factor and a between-subjects factor. Within-subjects factors test whether means change for a group, while between-subjects factors examine whether changes in means for groups differ over time (Bergh, 1995).

The assumptions for this design include the usual assumption for ANOVA (independence of observation between subjects and homogeneity of variance and normality of error) as well as an added assumption of sphericity (Glass & Hopkins, 1996). Independence of observation between subjects identifies that the two groups are independent of each other; this assumption is met in the proposed study as the measurements of the two groups are not dependent or associated in any way. Normality will be assessed using Shapiro-Wilk's test of normality while a Levene's test will check to see if the two groups have equal variance on the dependent variable. Sphericity indicates that equality is found in the variance of the different levels of the repeated measures factor. Mauchly's sphericity test will be used to evaluate sphericity; if this assumption is violated, the Huynh-Feldt adjustment will be used.

Results from the repeated measures ANOVA could have included several effects. The effect of interest for this study is identified.

- Group-by-Test interaction: This effect is of interest; a significant interaction indicates that differences between the intervention and comparison groups are not constant across the two tests.

This effect answered the primary questions of the study by identifying whether differences exist between experimental and comparison groups.

Limitations

As with any study, limitations exist for this project. In the secondary analysis of quantitative data, random assignment was not possible. Instead, a quasi-experimental design was used. The quasi-experimental design does offer advantages; this design minimizes threats to external validity since the design is not as artificial as a randomized

design setting. In addition, the use of self-selected groups in quasi-experimental studies reduces the chance of ethical and conditional concerns during the study (DeRue, 2012).

For three sets of items on the survey instrument (3 physical activity knowledge, 4 nutritional behavior, and 5 physical activity behavior items), the number of items is quite small. This small number of questions may be inadequate to assess these concepts.

Summary

This research consisted of analysis of secondary data obtained from HEAL intervention and comparison schools to determine whether differences exist in weight status, aerobic capacity, nutrition knowledge, physical activity knowledge, nutrition behavior, and physical activity behavior. The results of data analysis may be useful to identify whether the HEAL curriculum is efficacious, and what factors support those findings.

CHAPTER 4

RESULTS

Purpose of the Study

The purpose of this study was to determine whether students receiving the HEAL intervention showed greater improvements in BMI Z-scores, PACER scores, physical activity knowledge and behavior, and nutrition knowledge and behavior than comparison students at posttest measurement. As discussed in chapter 3, a repeated measures ANOVA was used to analyze outcomes.

This chapter presents results of the analyses for this research, including descriptive statistics. Analysis of variance (ANOVA) was chosen to study the sources of differences in student measurements, and a two-way (group-by-tests) repeated measures ANOVA was the design selected for these matched schools. The steps used in the repeated measures ANOVA included:

- Examine the two-way interaction.
- When the two-way interaction is not significant, examine main effects for each factor.
- When the two-way interaction is significant, examine simple main effects for each factor.

Several possible effects may appear in ANOVA results:

- Group-by-Test interaction: This effect is of interest. It indicates that differences between groups (intervention/comparison) are not consistent across the two tests (pretest/posttest).
- Main effect for Test: This effect is not of primary interest. It reveals whether differences exist between pretest and posttest but combines intervention and comparison schools.
- Main effect for Group: This effect is not of primary interest. It shows whether differences exist between the intervention and comparison schools but combines pretest and posttest measures.

Research Question 1

Research question 1 asked whether weight status is more improved in the intervention group than in the comparison group at posttest measurement as evidenced by BMI Z-scores. BMI Z-scores are a measure of relative weight which is adjusted for children's age and gender. Calculated relative to an external reference (i.e., CDC reference data), BMI Z-scores correspond to growth chart percentiles. For example, a Z-score of 0 is equal to the 50^{th} percentile (Lobstein et al., 2004). In the intervention group, the mean BMI z-score was .49, with a standard deviation of 1.12 at pretest. At posttest, intervention students had a mean BMI z-score of .54 with a standard deviation of 1.10. Comparison students had a mean pretest BMI z-score of .65 with a standard deviation of 1.11; at posttest, the comparison group had a mean BMI z-score of .65 with a standard deviation of 1.09, as shown in Table 17. These findings are shown graphically in Figure 2.

Table 17

BMI Z-score, Ns, Means, and Standard Deviations for Intervention and Comparison Students at Pretest and Posttest

	Intervention			Comparison		
	N	*M*	*SD*	*N*	*M*	*SD*
Pretest	323	.49	1.12	185	.65	1.11
Posttest	323	.54	1.10	185	.65	1.09

Figure 2

Mean BMI Z-scores of Intervention and Comparison Students at Pretest and Posttest

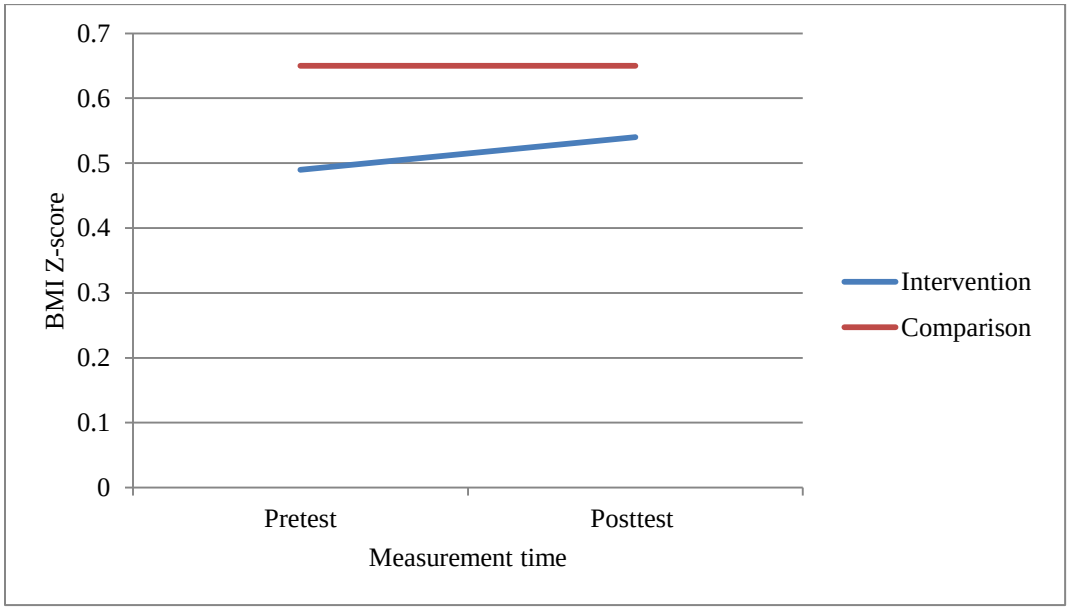


Table 18 presents the ANOVA summary results for BMI Z-scores. A significant effect was found for the group-by-test interaction, $F = 4.79$, $p = .029$. Therefore, simple main effects were examined, as presented in Table 19. As the results reveal, there was a significant difference from pretest to posttest for the intervention group (an increase instead of a decrease), but there was no significant difference from pretest to posttest for the comparison group. Furthermore, the intervention and comparison groups differed significantly at pretest as well as at posttest.

Table 18

BMI Z-score ANOVA Summary Table for Group by Test (Pre/Post)

Source	*df*	*SS*	*MS*	*F*	*p*
Group (intervention/comparison)	1	4.25	4.25	1.77	.185
Error Between	506	1218.51	2.41		
Test (pre/post)	1	.09	.09	3.19	.075
Group * Test Interaction	1	.14	.13	4.79	.029
Error Within	506	14.49	0.03		

Table 19

BMI Z-score Simple Effects Summary Table

Source	*SS*	*df*	*MS*	*ET*	*F*	F_{crit} 0.05	F_{crit} 0.01	
Test@Intervention	0.27	1	0.27	0.029	9.16	3.84	6.63 (df 1,∞)	**
Test@Comparison	0.00	1	0.00	0.029	0.09	3.84	6.63 (df 1,∞)	
Gp @ Pretest	3.42	1	3.42	0.029	117.77	3.84	6.63 (df 1,∞)	**
Gp @ Posttest	1.65	1	1.65	0.029	57.04	3.84	6.63 (df 1,∞)	**

**=$p < .01$

Additional analyses

To further explore weight status, additional analyses were conducted to determine the prevalence of obesity for each group or subgroup in the analysis. Prevalence was determined by dividing the number of obese students (i.e., students with BMI-for-age >95%ile) by the number of students in the intervention status. Obesity prevalence was identified for pretest and posttest by intervention group, by schools, between genders, by school minority status, and by school poverty status. As presented in Table 20, the prevalence of obesity among intervention students was 17.8% at pretest and 18.6% at posttest. For comparison students the prevalence was 22.8% at pretest and 23.8% at posttest.

Table 20

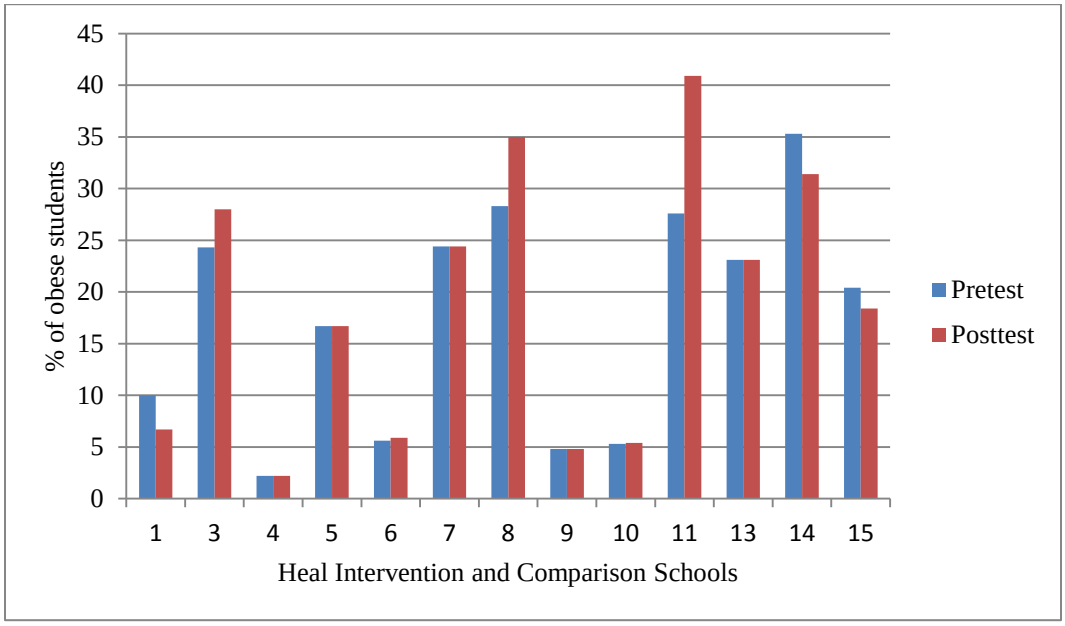
Numbers and Prevalence of Obesity at Pretest and Posttest for HEAL Intervention and Comparison Students

	Pretest	Posttest
Intervention	64/359 students; 17.8%	60/323 students; 18.6%
Comparison	44/193 students; 22.8%	42/185 students; 23.8%

Fifteen schools were initially involved in the 2010-2011 HEAL study; however, the data from schools 2 and 12 could not be used due to apparent coding errors. As seen in Figure 3, the 13 schools are identified as 1-15 excluding schools 2 and 12; schools 1-9 were intervention schools and schools 10-15 were used for comparison. Prevalence rates for intervention schools ranged from 2.2% - 28.3% at pretest and 2.2% - 35.0% at posttest. Comparison schools had prevalence rates from 5.3% - 35.3% at posttest and 5.4% - 40.9% at posttest. The range of obesity prevalence was lower in intervention students at both pretest and posttest.

Figure 3

Prevalence of Obesity in HEAL Intervention and Comparison Students by School

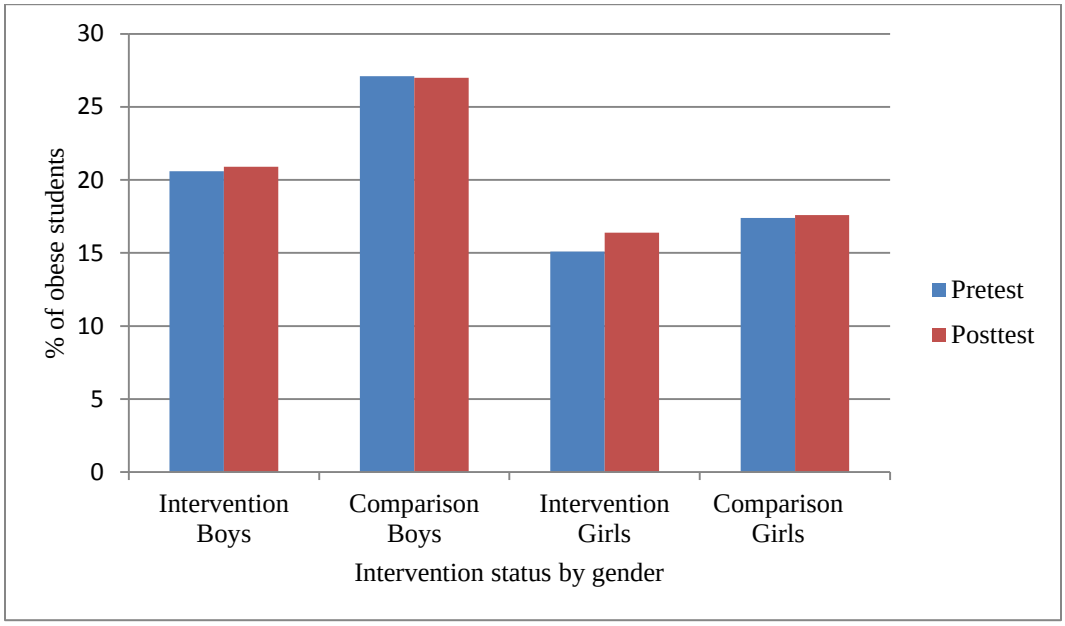


Note: Schools 1-9 = Intervention; Schools 10-15 = Comparison

Figure 4 visually presents the differences in prevalence of obesity among intervention and comparison student by gender. Rates ranged from 15.1%, seen in intervention girls, to 27.1%, as observed in comparison boys. At posttest, obesity prevalence ranged from 16.4% in intervention girls to 27.0% in comparison boys. For both intervention and comparison groups, obesity prevalence was higher among boys than girls; the highest prevalence of obesity was observed among boys in the comparison group.

Figure 4

Prevalence of Obesity in HEAL Intervention and Comparison Students by Gender



To observe any differences in obesity prevalence by minority status in this project, the schools were separated into three categories. The definitions used to compare minority status are the same as those used by the U.S. Department of Education, National Center for Education Statistics. A *High Minority* school has greater than 50% minority students. *Medium Minority* schools are composed of 5% - 50% minority students, and *Low Minority* schools have less than 5% minority students (Aud et al., 2011). A summary of HEAL intervention and comparison schools by minority status is shown in Table 21.

Table 21

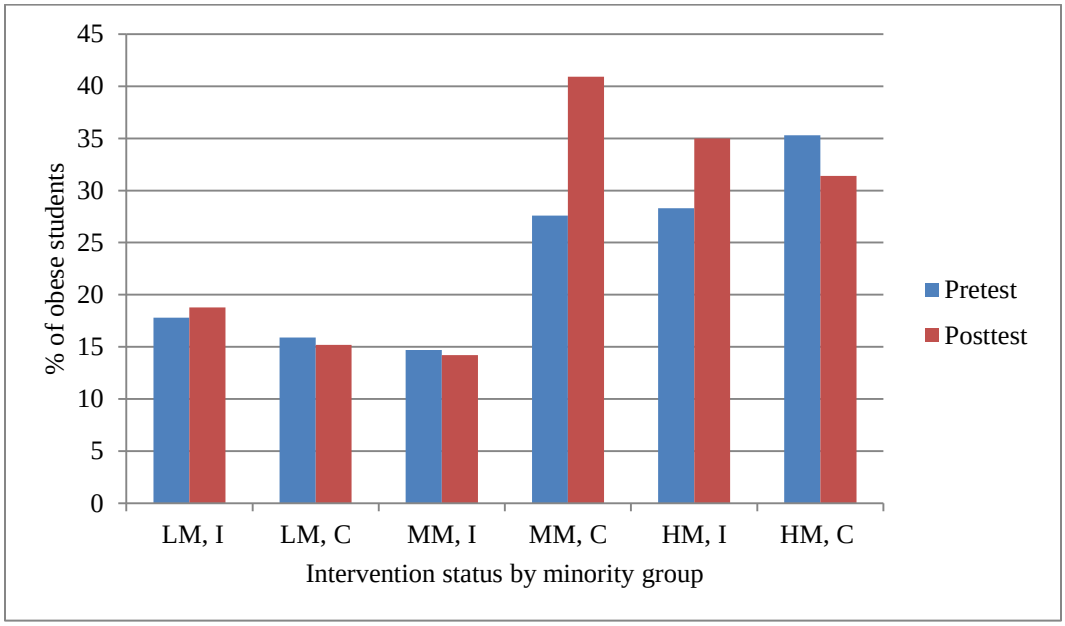
HEAL Intervention and Comparison Schools by Minority Status

	Intervention	Comparison
Low Minority	2 schools (192 students)	3 schools (73 students)
Medium Minority	5 schools (152 students)	1school (28 students)
High Minority	1school (45 students)	1school (50 students)

Figure 5 visually presents the prevalence of obesity by school minority status pretest and posttest for intervention and comparison students. The highest prevalence (40.9%) and the greatest increase from pretest to posttest (27.6% - 40.9%) is seen in the *Medium Minority* category for comparison schools. In contrast, the *Medium Minority* intervention school category showed a slight decrease (14.7% - 14.2%) in prevalence.

Figure 5

Prevalence of Obesity in HEAL Intervention and Comparison Schools by Minority Status



Note: LM, I = Low Minority, Intervention; LM, C = Low Minority, Comparison; MM,I = Medium Minority, Intervention; MM, C = Medium Minority, Comparison; HM, I = High Minority, Intervention; HM, C = High Minority, Comparison

Differences in poverty status were also identified. As with definitions for minority status, the definitions used to compare poverty status are the same as those used by the U.S. Department of Education, National Center for Education Statistics. In *Low Poverty* schools, 25% or fewer students received free or reduced lunch. *Medium Poverty*

schools provide free or reduced lunch to 26% - 75% of students, and in *High Poverty* schools, 76% or more of students are eligible for free or reduced lunch (Aud et al., 2012).

A summary of HEAL intervention and comparison schools by poverty status is shown in Table 22. Figure 6 presents the prevalence of obesity in HEAL intervention and comparison schools at pretest and posttest based on poverty status of school. The lowest prevalence of obesity was observed in Low Poverty schools. As school poverty status increased, the prevalence of obesity increased as well. Obesity prevalence was consistent from pretest to posttest with the exception of the High Poverty, Intervention category. An increase from 28.3% at pretest to 35.0% at posted was observed. In the High Poverty category, data from only 1 intervention school is available. (The data from the 2 schools that had to be excluded would have added 1 intervention school and 1 comparison school to this category).

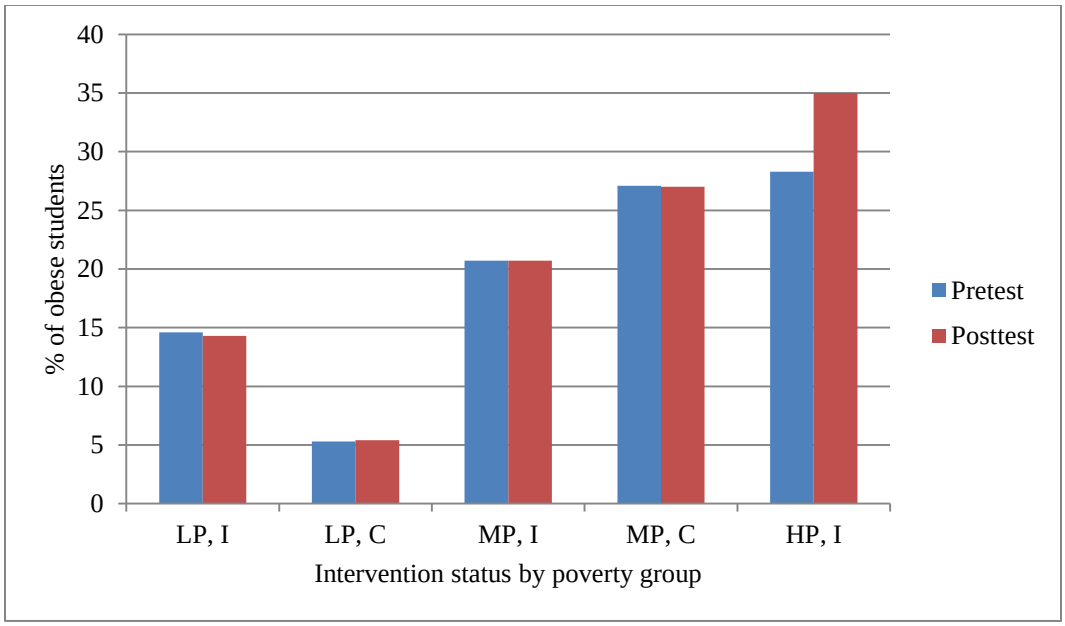
Table 22

HEAL Intervention and Comparison Schools by Poverty Status

	Intervention	Comparison
Low Poverty	5 schools (222 students)	1 school (37 students)
Medium Poverty	2 schools (85 students)	4 schools (151 students)
High Poverty	1 school (45 students)	n/a

Figure 6

Prevalence of Obesity in HEAL Intervention and Comparison Schools by Poverty Status



Note: LP, I = Low Poverty, Intervention; LP, C = Low Poverty, Comparison; MP, I = Medium Poverty, Intervention; MP, C = Medium Poverty, Comparison; HP, I = High Poverty, Intervention

Research question 2

Research question 2 asked whether PACER scores are more improved in the intervention group than in the comparison group at posttest measurement. PACER scores could range from 0 – 75 laps. Table 23 presents descriptive statistics for the PACER measurement. At pretest, intervention students had a mean PACER score of 23.98 with a standard deviation of 13.61; at posttest, the mean score was 26.93 with a standard deviation of 14.29 for the intervention students. Comparison students had a mean PACER score of 23.02 with a standard deviation of 13.25 at pretest and a mean score of 23.94 with a standard deviation of 14.58 at posttest. Figure 3 depicts graphically the performances of the two groups at pretest and posttest.

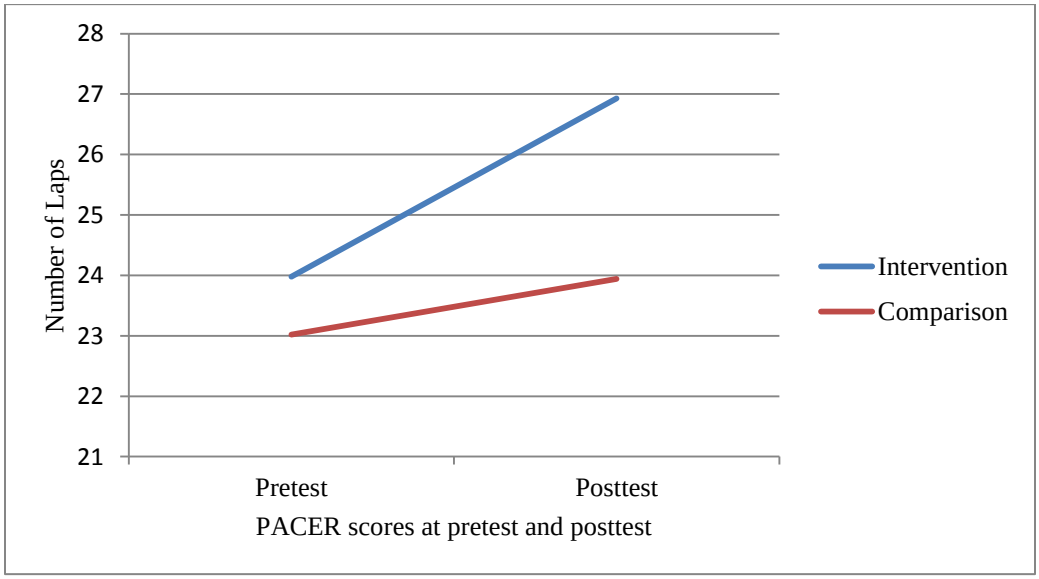
Table 23

Ns, Means, and Standard Deviations for PACER Scores at Pretest and Posttest for Intervention and Comparison Students

	Intervention			Comparison		
	N	Mean	SD	N	Mean	SD
Pretest	332	23.98	13.61	155	23.02	13.25
Posttest	332	26.93	14.29	155	23.94	14.58

Figure 7

Mean PACER Scores for Intervention and Comparison Students at Pretest and Posttest



ANOVA summary results for PACER scores, shown in Table 24, indicated a significant effect for group-by-test interaction, $F = 22.61$, $p < .000$. Therefore, simple main effects were examined, as shown in Table 25**.** As the results reveal, there was a significant difference from pretest to posttest for the intervention group (an increase in the number of laps), but there was no significant difference from pretest to posttest for the comparison group. Furthermore, the intervention and comparison groups differed significantly at posttest. Figure 7 depicts these findings.

Table 24

PACER Score ANOVA Summary Table for Group by Test (Pre/Post)

Source	*df*	*SS*	*MS*	*F*	*p*
Group (intervention/comparison)	1	481.51	481.51	1.33	.250
Error Between	4.85	175714.99	362.30		
Test (pre/post)	1	271.75	271.75	7.80	.003
Group * Test Interaction	1	698.36	698.36	22.61	.000
Error Within	485	14980.37	30.89		

Table 25

PACER Simple Effects Summary Table

Source	*SS*	*df*	*MS*	*ET*	*F*	F_{crit} 0.05	F_{crit} 0.01	
Test@Intervention	1444.61	1	1444.61	33.67	42.90	3.84	6.63 (df 1,∞)	**
Test@Comparison	77.02	1	77.02	33.67	2.29	3.84	6.63 (df 1,∞)	
Gp @ Pretest	108.34	1	108.34	33.67	3.32	3.84	6.63 (df 1,∞)	
Gp @ Posttest	1050.97	1	1050.97	33.67	27.90	3.84	6.63 (df 1,∞)	**

**=$p < .01$

Additional analyses

PACER scores can be categorized by gender and age as *Needs Improvement, Healthy, or High Fitness Zone* (Alabama Department of Education, 2011). Table 26 presents a comparison of these categories at pretest and posttest for intervention and comparison students. Among boys, the percentage of students in the *Needs Improvement* category declined from 45% to 33% in the intervention group, while the percentage of boys in the comparison group that *Needs Improvement* rose slightly from 53% to 54%. A decrease in the percentage of girls in the *Needs Improvement* category was noted in both intervention and comparison students, with a greater decrease for intervention girls. Intervention girls moved from 30% to 21%, and comparison girls decreased from 34% to

29%. The differences noted indicate improved aerobic fitness among intervention students.

Table 26

Rates of HEAL Intervention and Comparison Boys and Girls in PACER Fitness Categories

	Boys			
	Intervention		Comparison	
	Pretest	Posttest	Pretest	Posttest
Needs Improvement (0-22 laps)*	45%	33%	53%	54%
Healthy (23-61 laps)*	53%	62%	45%	46%
High Fitness Zone (>61 laps)*	2%	5%	2%	2%
	Girls			
	Intervention		Comparison	
	Pretest	Posttest	Pretest	Posttest
Needs Improvement (0-14 laps)*	30%	21%	34%	29%
Healthy (15-41 laps)*	63%	71%	59%	62%
High Fitness Zone (>41 laps)*	7%	8%	7%	9%

*Alabama Department of Education. (2011). Alabama physical fitness assessment test administrator manual, draft. Retrieved February 26, 2012 from: http://qualtitypeinalabama.pbworks.com/f/Alabama+Physical+Fitness+Assessment+(Draft).pdf

Research Question 3

Research question 3 asked whether nutrition knowledge scores are higher in the intervention group than the comparison group at posttest measurement. For each of the 14 items, a score of 1 was assigned for correct responses; 0 points were assigned for incorrect answers. Cronbach's alpha coefficients were calculated for the 14 nutrition knowledge questions to give estimates of internal consistency reliabilities for the set of questions. A Cronbach's alpha of .673 was obtained for the original 14 nutrition knowledge questions. Analysis plans for grouped items required a value of .7 for Cronbach's alpha. Table 27 shows the item-analysis statistics.

Table 27

Cronbach's Alpha Item-Total Statistics for Combined Nutrition Knowledge Items

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Pre item 7a	9.22	33.411	.100	.150	.695
Pre item 7b	9.34	33.705	.033	.095	.700
Pre item 7c	9.19	33.312	.126	.172	.694
Pre item 7d	9.14	33.529	.098	.099	.695
Pre item 7e	9.14	33.473	.111	.175	.694
Pre item 13	9.65	30.082	.299	.169	.678
Pre item 14	9.06	28.668	.245	.196	.694
Pre item 15	9.29	26.095	.432	.267	.658
Pre item 17	9.70	30.310	.281	.159	.680
Pre item 20	9.19	28.791	.564	.507	.648
Pre item 21	9.05	28.337	.468	.385	.654
Pre item 22	9.10	28.272	.421	.317	.660
Pre item 23	9.19	26.470	.499	.347	.645
Pre item 24	9.04	27.285	.418	.285	.659

After reviewing the item-analysis statistics for the original 14 nutrition knowledge items, a second Cronbach's alpha was performed using the 9 items with item-total correlations of at least .200. This eliminated items 7a – 7e from the analysis. A Cronbach's alpha of .732 was found for nutrition knowledge items 13, 14, 15, 17, 20, 21, 22, 23, and 24. Item-analysis statistics are presented for those 9 items in Table 28.

Table 28

Cronbach's Alpha Item-Total Statistics for 9 Nutrition Knowledge Items

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Pre item 13	5.93	27.899	.359	.229	.698
Pre item 14	5.35	26.313	.319	.189	.709
Pre item 15	5.56	24.321	.422	.243	.689
Pre item 17	5.96	28.182	.301	.200	.707
Pre item 20	5.49	27.816	.532	.466	.679
Pre item 21	5.35	27.274	.416	.316	.688
Pre item 22	5.41	27.233	.408	.304	.689
Pre item 23	5.49	25.547	.454	.289	.679
Pre item 24	5.35	26.291	.407	.278	.689

It was decided that these 9 items would be summed to comprise the nutrition knowledge scale, and the remaining 5 items would be analyzed individually. Scores for the nutrition knowledge scale could range from 0 (no knowledge) to 9 (high knowledge). Table 29 presents descriptive statistics for the nutrition knowledge scale by time and intervention status. These findings are shown graphically in Figure 8. Mean pretest nutrition knowledge scores were 4.61 (SD = 1.49) for intervention students and 4.49 (SD = 1.45) for comparison students. Mean posttest scores were 5.75 (SD = 1.59) for intervention students and 4.87 (SD = 1.44) for comparison students.

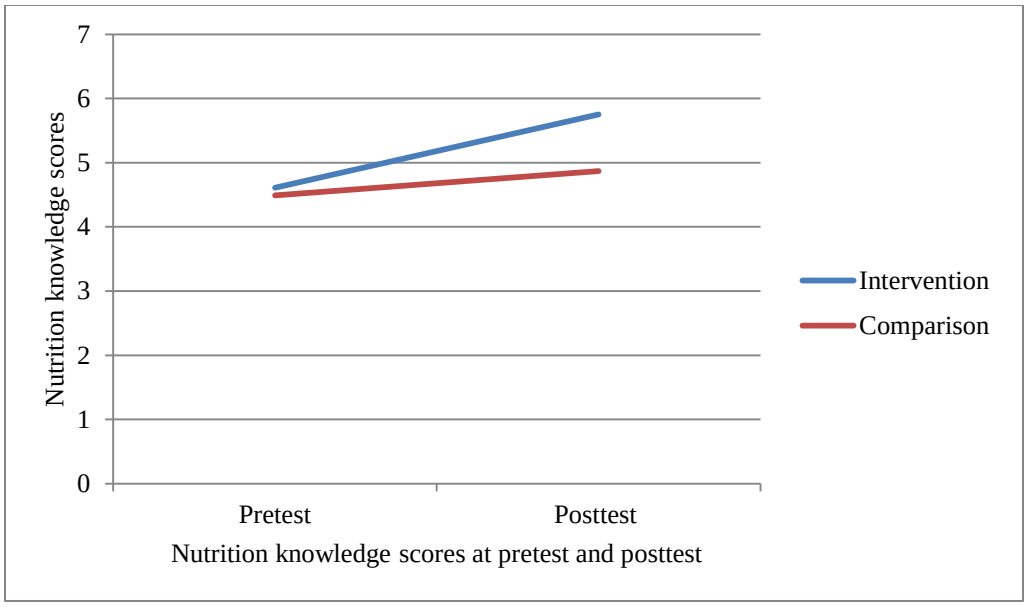
Table 29

Ns, Means, and Standard Deviations for Grouped Nutrition Knowledge Set

	Intervention			Comparison		
	N	Mean	SD	N	Mean	SD
Pretest	325	4.61	1.49	159	4.49	1.45
Posttest	325	5.75	1.59	159	4.87	1.44

Figure 8

Nutrition Knowledge Scale Mean Scores for Intervention and Comparison Students at Pretest and Posttest



ANOVA summary results for the nutrition knowledge scale, shown in Table 30, indicate a significant interaction effect for group-by-test, $F = 18.23$, $p < .000$. Therefore, simple main effects were examined as shown in Table 31. The results revealed a significant difference from pretest to posttest for both groups (scores increased at posttest). The intervention and comparison groups did not differ significantly at pretest; at posttest a significant difference between groups was found (the intervention group had a higher mean score). Figure 8 depicts these findings.

Table 30

Nutrition Knowledge Score ANOVA Summary Table for Group by Test (Pre/Post)

Source	*df*	*SS*	*MS*	*F*	*p*
Group (intervention/comparison)	1	52.87	52.87	18.23	.000
Error Between	482	1397.86	2.90		
Test (pre/post)	1	123.18	123.18	74.79	.000
Group * Test Interaction	1	30.17	30.17	18.32	.000
Error Within	482	793.82	1.65		

Table 31

Nutrition Knowledge (Grouped Items) Simple Effects Summary Table

Source	*SS*	*df*	*MS*	*ET*	*F*	F_{crit} 0.05	F_{crit} 0.01	
Test@Intervention	215.73	1	215.73	1.65	130.99	3.84	6.63 (df 1,∞)	**
Test@Comparison	13.14	1	13.14	1.65	7.98	3.84	6.63 (df 1,∞)	**
Gp @ Pretest	1.69	1	1.69	1.65	1.03	3.84	6.63 (df 1,∞)	
Gp @ Posttest	91.04	1	91.04	1.65	55.84	3.84	6.63 (df 1,∞)	**

**=$p < .01$

Nutrition knowledge items not included in group

For the 5 nutrition knowledge items not included in the group, students were asked to identify the healthier choice between 2 foods or beverages (7a – pretzels or potato chips, 7b – whole milk or skim milk, 7c – whole wheat bread or white bread, 7d – fruit drink or 100% fruit juice, 7e – frozen yogurt or ice cream).

A chi-square with separate analyses for pre and post for each of the 5 items was performed using a .01 significance level due to the number of items and large sample size. These were 2 x 2 chi-square tests with 1 degree of freedom and a critical value of 6.63 (Hopkins & Glass, 1978).

Means, standard deviations, and chi-square values for the individual nutrition knowledge items are shown in Table 32. No significant differences were found at

pretest; however, results revealed a significant difference at posttest for 2 items. Items 7b and 7c chi-squares indicated no significant difference at pretest but a significant difference at posttest for each item. A significant difference in knowledge for both items was found between intervention and comparison students.

Table 32

Pretest and Posttest Means, Standard Deviations and Chi-Square Values for Nutrition Knowledge Items 7a – 7e

	Pretest			Posttest			
Item	Intervention	Comparison	Obs	Intervention	Comparison	Obs	
	M (SD)	*M (SD)*	χ^2	*M (SD)*	*M (SD)*	χ^2	
7a	.71 (.46)	.74 (.44)	0.54	.86 (.35)	.81 (.40)	2.36	
7b	.59 (.49)	.64 (.48)	1.37	.80 (.40)	.68 (.47)	8.39	*
7c	.75 (.44)	.77 (.42)	0.34	.90 (.30)	.81 (.39)	8.51	*
7d	.78 (.42)	.83 (.39)	2.23	.92 (.27)	.94 (.23)	0.98	
7e	.80 (.40)	.82 (.39)	0.18	.93 (.25)	.89 (.32)	3.14	

*=$p < .01$

Research Question 4

Research question 4 asked whether physical activity knowledge scores were higher in the intervention group than the comparison group at posttest measurement. Cronbach's alpha coefficients were calculated for the 3 physical activity knowledge questions to give estimates of internal consistency reliabilities for the set of questions. A Cronbach's alpha of .132 was obtained for the 3 physical activity knowledge questions. Table 33 shows the item-analysis statistics.

Analysis plans for grouped items required a value of .7 for Cronbach's alpha. This group of questions did not meet the required Cronbach's alpha; therefore, these 3 questions are reported separately.

Table 33

Cronbach's Alpha Item-Total Statistics for Combined Physical Activity Knowledge Items

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Pre item 16	.60	.415	.068	.005	.082
Pre item 18	1.01	.322	.055	.003	.120
Pre item 19	1.23	.404	.073	.006	.069

Again, data were analyzed using 2 x 2 chi-square tests with 1 degree of freedom and a critical value of 6.63 (Hopkins & Glass, 1978). The chi-square tests for individual physical activity knowledge questions revealed a significant difference was found for each of these items at posttest. As shown in Table 34, posttest scores of intervention students were significantly different from those of comparison students.

Table 34

Pretest and Posttest Means, Standard Deviations, and Chi-Square Values for Physical Activity Knowledge Items

	Pretest			Posttest			
	Intervention	Comparison	Obs	Intervention	Comparison	Obs	
Item	*M* (*SD*)	*M* (*SD*)	χ^2	*M* (*SD*)	*M* (*SD*)	χ^2	
16	0.85 (.36)	0.77 (.42)	5.18	0.90 (.31)	0.79 (.41)	10.53	*
18	0.42 (.49)	0.41 (.49)	0.29	0.81 (.39)	0.42 (.40)	87.16	*
19	0.21 (.41)	0.16 (.37)	1.64	0.68 (.47)	0.17 (.37)	142.50	*

*=p<.01

Research Question 5

Research question 5 asked whether nutrition behavior scores were higher in the intervention group than the comparison group at posttest. Cronbach's alpha coefficients were calculated for the 4 nutrition behavior questions to give estimates of internal consistency reliabilities for the set of questions. A Cronbach's alpha of .101 was obtained for the 4 questions. Table 35 shows the item-total statistics. Analysis plans for

grouped items required a value of .7 for Cronbach's alpha. This group of questions did not meet the required Cronbach's alpha; therefore, these 4 questions are reported separately.

Table 35

Cronbach's Alpha Item-Total Statistics for Combined Nutrition Behavior Questions

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Pre item 2	8.34	5.617	.037	.095	-.086
Pre item 3	8.06	5.952	.177	.087	-.283
Pre item 4	9.60	6.671	.126	.066	-.171
Pre item 6	9.71	7.732	-.222	.055	.416

In nutrition behavior item 2, students were asked how many days they ate breakfast during the last week. Options were: *Never* (0 points), *1-2 days* (1 point), *3-4 days* (2 points), *5-6 days* (3 points), or *Every day* (4 points). Nutrition behavior item 3 asked students to identify how many times in the last week they ate something from a fast food restaurant? Options were: *Never* (5 points), *1-2 times* (4 point), *3-4 times* (3 points), *5-6 times* (2 points), *7 times* (1 points), or *More than 7 times* (0 points). In nutrition behavior item 4, students were asked to identify how often they snack while watching television. Answer options include: *Never* (4 points), *Rarely* (3 points), *Sometimes* (2 points), *Usually* (1 point), and *Always* (0 points). Nutrition behavior item 6 asked students how many times their family ate a meal together. Options were: *Never* (0 points), *1-2 times* (1 point), *3-4 times* (2 points), *5-6 times* (3 points), *7 times* (4 points), and *More than 7 times* (5 points). Items 2 and 4 were 5 x 2 chi-square tests with 4

degrees of freedom and a critical value of 13.3. Items 3 and 6 were a 6 x 2 chi square test with 5 degrees of freedom and a critical value of 15.1 (Hopkins and Glass, 1978). Table 36 presents pretest and posttest means, standard deviations, and chi-square values for nutrition behavior items.

Table 36

Pretest and Posttest Means, Standard Deviations, and Chi-Square Values for Nutrition Behavior Items

	Pretest				Posttest		
	Intervention	Comparison	Obs		Intervention	Comparison	Obs
Item	*M* (*SD*)	*M* (*SD*)	χ^2		*M* (*SD*)	*M* (*SD*)	χ^2
2	2.95 (1.43)	2.15 (1.79)	52.80	*	3.24 (1.27)	3.24 (1.21)	3.96
3	4.61 (0.97)	4.67 (0.78)	7.17		4.74 (0.74)	4.75 (.68)	1.07
4	1.52 (1.11)	1.88 (1.03)	20.86	*	1.59 (1.10)	1.75 (1.00)	9.63
6	2.11 (1.69)	2.37 (1.88)	11.61		3.30 (1.65)	2.96 (1.76)	12.34

*p=<.000

A significant difference was found at pretest measurement for items 2 and 4. On item 2, more comparison students responded *Never* eating breakfast than did intervention students. At pretest, more students in the intervention group responded *Always* and *Usually* than did comparison students on item 4, and more comparison students reported *Sometimes* than did intervention students.

Research Question 6

Research question 6 asked whether physical activity behavior scores were higher in the intervention group than the comparison group at posttest. Cronbach's alpha coefficients were calculated for the 5 physical activity behavior questions to give estimates of internal consistency reliabilities for the set of questions. A Cronbach's alpha of .555 was obtained for the 5 physical activity behavior questions. Table 37 presents the item-total statistics.

Analysis plans for grouped items required a value of .7 for Cronbach's alpha. This group of questions did not meet the required Cronbach's alpha; therefore, these 5 questions are reported separately.

Table 37

Cronbach's Alpha Item-Total Statistics for Combined Physical Activity Behavior Items

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Pre item 11a	8.56	5.016	.458	.217	.399
Pre item 11b	8.49	4.892	.330	.168	.488
Pre item 11c	8.11	6.177	.335	.118	.489
Pre item 11f	8.91	5.913	.224	.070	.545
Pre item 12	8.20	6.220	.245	.067	.529

In each physical activity behavior question, answer options included: *Never* (0 points), *Sometimes* (1 point), *Usually* (2 points), and *Always* (3 points). Item 11a asked how often students get 30 minutes of physical activity after school. In item 11b, students were asked how often they participate in a team sport. Item 11c asked how often students are very active during PE classes. In 11d, students were asked how often they would rather be outside playing than inside watching TV or video games, and 11e asked how frequently they enjoy doing activities that cause the heart to beat faster (like playing sports, jumping rope, or swimming). Finally, item 11f asked how often students walk up stairs rather than taking the elevator or escalator.

Means for the individual physical activity behavior items are shown in Table 38. No significant differences were found at pretest or posttest.

Table 38

Pretest and Posttest Means, Standard Deviations, and Chi-Square Values for Physical Activity Behavior Items 11a – 11f

	Pretest			Posttest		
	Intervention	Comparison	Obs χ^2	Intervention	Comparison	Obs χ^2
11a	2.09 (1.18)	2.02 (1.19)	4.46	2.40 (0.93)	2.32 (1.10)	6.86
11b	2.13 (1.13)	1.98 (1.22)	3.37	2.22 (1.05)	2.05 (1.16)	5.89
11c	2.43 (0.73)	2.48 (0.76)	4.73	2.44 (0.70)	2.47 (0.72)	3.73
11d	2.09 (0.87)	1.99 (0.92)	6.44	2.11 (0.85)	2.03 (0.87)	1.32
11e	2.53 (0.72)	2.45 (0.82)	4.23	2.46 (0.77)	2.53 (0.66)	4.82
11f	1.64 (0.97)	1.70 (0.98)	0.72	1.61 (0.93)	1.79 (0.90)	5.56

Question 12 addressed the converse of physical activity by examining physical inactivity. Students were asked how many hours they spend each day watching TV or playing video games or computer games. Options were: *More than 6 hours* (0 points), *4-6 hours* (1 point), *2-4 hours* (2 points), and *Less than 2 hours* (3 points). No differences were found at pretest or posttest.

Table 39

Pretest and Posttest Means and Standard Deviations for Physical Inactivity Item 12

	Pretest			Posttest		
Intervention	Comparison	Obs χ^2	Intervention	Comparison	Obs χ^2
2.40 (0.80)	2.29 (.90)	4.65	2.39 (0.78)	2.26 (0.84)	4.12

CHAPTER 5

DISCUSSION

Conclusions

The research design for this study was a secondary data analysis of a quasi-experimental study conducted in elementary schools in 2010-2011. The study was guided based on the research questions identified below. A discussion of the findings is presented after each research question.

Research Question 1

Does the HEAL PE curriculum improve weight status of fifth grade students as evidenced by body mass index (BMI) scores when compared to scores from students enrolled in comparison schools?

In this study, weight status was not observed to be more improved among the intervention group than the comparison group at posttest measurement. Intervention students had a mean BMI z-score of .49 at pretest and .54 at posttest; comparison students had mean BMI z-scores of .65 at pretest and .65 at posttest. The intervention and comparison students differed at both measurements. An increase in mean BMI z-score from pretest to posttest produced a difference in the measurement points for intervention students; no change in mean BMI z-score was observed among comparison students. Other researchers have also reported a lack of favorable results (Sallis et al., 1993, Pangrazi et al., 2003, Harrison et al., 2006, Robbins et al., 2006). In contrast, some

authors have observed desirable changes in weight status (Amaro et al., 2006, Angelopoulos et al., 2009, Greening et al., 2011).

Weight status was also observed by examining the prevalence of obesity in the groups. At posttest measurement, increases were observed in both groups as the prevalence of obesity was 18.6% in intervention students and 23.8% in comparison students. The prevalence of obesity among intervention students at posttest is the same as the 2010-2011 childhood obesity rate of 18.6% in Alabama determined through the National Survey of Children's Health. Obesity rates among intervention students were also similar to Geiger and colleagues (2009) findings of 18.0% prevalence of obesity among fifth grade students in the Birmingham metropolitan area. Both intervention and comparison groups had higher rates of obesity in 2010-2011 than the 15.7% nationally as determined by the National Survey of Children's Health.

The obesity prevalence rates for intervention schools ranged from 2.2% - 28.3% at pretest and 2.2% - 35.0% at posttest. Comparison schools had prevalence rates from 5.3% - 35.3% at posttest and 5.4% - 40.9% at posttest. This variation in prevalence of obesity suggests that school characteristics may influence the likelihood of obesity.

Differences in childhood obesity prevalence by race and ethnicity have been reported in the literature (Flores, 2010; Hedley, Ogden, Johnson, Carroll, Curtin, & Flegal, 2002; Oberg & Rinaldi, 2006). This study revealed differences in prevalence rates by minority status of schools. At pretest, the highest prevalence rates were observed among high minority schools, closely followed by the medium minority comparison school. At posttest, the prevalence rate of the medium minority comparison school surpassed that of the high minority schools.

In their 2009 meta-analysis, Cook-Cottone, Casey, and Feeley noted significant and positive effects seen in interventions aimed at Asian students and predominately white students, while no significant effects were found in interventions targeting non-Hispanic black or Hispanic students. In contrast, Greening et al. (2011) studied 450 children ages 6-10 years old in rural Mississippi with approximately 66% of the participants identified as non-Hispanic black students. The authors noted that obesity prevalence did not increase from pretest to posttest for intervention students (32%/32%) but an increase from 33% at pretest to 38% at posttest was observed for comparison students.

Differences in obesity prevalence rates by poverty status were also noted with obesity prevalence increasing as school poverty status increased. These findings are similar to those found by Singh & Kogan (2010) as well as data available from the National Survey of Children's Health for the 2010-2011 period.

Prevalence findings for both minority status and poverty status schools underscore the importance of intervening in the lives of children to change the trajectory of lifelong health status.

Research Question 2

Does the HEAL PE curriculum improve fitness levels of fifth grade students as evidenced by PACER (Progressive Aerobic Cardiovascular Endurance Run) test scores when compared to scores from students enrolled in comparison schools?

PACER scores increased from pretest to posttest among intervention students, and PACER scores differed at posttest between intervention and comparison students at posttest, indicating improved fitness levels. In contrast, PACER scores did not differ

from pretest to posttest among comparison students. Similarly, Jamner and colleagues (2004) observed improved cardiovascular fitness among children receiving an intervention.

Research Question 3

Does the HEAL PE curriculum improve nutrition knowledge as evidenced by nutrition knowledge questionnaire scores when compared to scores from students enrolled in comparison schools?

The summed nutrition knowledge score was observed to increase among intervention students. Amaro and colleagues (2006) also found an increase in nutrition knowledge among students receiving an intervention.

Research Question 4

Does the HEAL PE curriculum improve physical activity knowledge as evidenced by physical activity knowledge questionnaire scores when compared to scores from students enrolled in comparison schools?

Increases in scores were observed for all 3 physical activity knowledge items. Comparable studies could not be identified that measured physical activity knowledge.

Research question 5

Does the HEAL PE curriculum improve nutrition behaviors of fifth grade students as evidenced by behavior questionnaire scores when compared to scores from students enrolled in comparison schools?

No differences were observed in nutrition behaviors between the two groups at posttest. Similarly, Spiegel & Foulk (2006) reported no significant differences in dietary

intake between groups. Other authors have reported specific dietary behavior changes following an intervention. Increased fruit and vegetable intake was reported by Angeloulos and colleagues (2009) for all intervention students, and Gortmaker et al. (1999) observed increased fruit and vegetable consumption among girls in their intervention. James et al. (2004) observed reduced consumption of carbonated beverages, and Robinson and colleagues (1999) reported reduced eating time in front of television for intervention students.

Research Question 6

Does the HEAL PE curriculum improve physical activity behaviors of fifth grade students as evidenced by behavior questionnaire scores when compared to scores from students enrolled in comparison schools?

No changes were observed in physical activity or physical inactivity behaviors pretest to posttest. Results for altering physical activity behaviors are mixed in the literature. Spiegel & Foulk (2006), Kipping, Payne, & Lawlor (2008), and Sahota et al. (2001) reported no significant effects for physical activity or sedentary behaviors. In contrast, Gortmaker et al. (1999b) reported reduced hours of television for intervention boys and girls, and Angelopoulos and colleagues (2009) observed increased physical activity among intervention children and decreased physical activity among comparison children.

Conceptual Framework

As identified in Chapter 2, the Social Ecological Model (SEM) and Life Course Perspective were used were used as the conceptual framework of this study. The SEM posits that behavior is both affected by and affects multiple levels of influence. In the Social Ecological Model, the individual holds the core position and encircling layers

identify larger groups that influence a person. The model identifies five layers of influence including individual, interpersonal, organizational (or institutional), community, and public policy (McLeroy et al., 1988).

On the individual (or intrapersonal) level, influences include factors such as knowledge, attitude, behaviors, perceived barriers, age, gender, preferences, and self-efficacy. Interventions at this level seek to change characteristics of the individual through means such as educational programs, support groups, and mass media (Sisson et al., 2009). In this study, no improvement in individual factors such as weight status (as evidenced by BMI Z-score), nutrition behaviors, and physical activity behaviors. However, improvements were observed for fitness level (as evidenced by the PACER test), nutrition knowledge and physical activity knowledge.

The interpersonal level identifies that family, friends, and social networks can impact behavior, which may result from social support and identity (McLeroy et al., 1988). Several target behaviors that interact with this level of influence were evaluated including items concerning frequency of eating breakfast, frequency of family meals, frequency of eating at a fast food restaurant, and frequency of eating while watching television.

Organizational factors include rules and policies that affect the individual by preventing or promoting a behavior. School based interventions address the organizational level. As seen previously, mean BMI Z-scores differed among schools. Some of the organizational factors that may influence these findings include district and local school requirements for PE classes, local school administration support for PE

program, length of PE class, size of PE class, school wellness policies, and location of school.

Two concerns that may have affected this study are worth noting. First, among intervention schools, no fidelity studies were conducted. As a result, it is unclear if all components of the intervention were conducted, or if they were conducted as designed. A lack of adherence to the curriculum may have prevented more positive results among intervention students. Second, schools used for comparison were to begin the HEAL program the next school year. The PE teachers in comparison schools may have altered their curriculum in expectation of the upcoming HEAL program. If so, this could account for a lack of difference between the two groups at posttest.

At the community level, behaviors can be influenced by the social norms that exist among groups of individuals and organizations (McLeroy et al., 1988). Cultural norms related to health behaviors and school SES may have influenced the findings in this study.

At the public policy level, authoritative decisions made by governing bodies can regulate certain health behaviors. Interventions at this level could address any local, state, or national policies or laws that impact physical activity and eating behaviors. This study was influenced at the public policy level by the use of the HEAL curriculum in intervention schools.

Life Course Perspective

The Life Course Perspective identifies childhood as a significant period in establishing lifelong health because health is produced through the span of one's life (Barker, 2002). Factors like genetics, physiology, behavior, and the social/built environment interact with each other over the life course, and different determinants

become more or less important at different stages of life (Kuh & Ben-Shlomo, 2004). Obesity is generally preventable (World Health Organization, 2009), and children who are obese tend to become obese adults; once obesity develops, it is notoriously difficult to treat (Whitaker et al., 1997).

Eliminating health disparities is a national goal (U.S. Department of Health and Human Services, 2010). Childhood obesity and its related consequences continue to present a major disparity with non-Hispanic blacks, Hispanic/Mexican-Americans, and children from low-income homes having a greater prevalence of obesity (Koplan, Liverman, & Kraak, 2004). Health disparities were observed in this study based on school poverty and school minority status. As shown in Table 39, for both intervention and comparison students, as school poverty status increased, the prevalence of obesity increased as well. Concerning poverty status, the prevalence of obesity was less in *Low Minority* schools than in *High Minority* schools for both intervention and comparison groups. However, the lowest prevalence of obesity at pretest and posttest was observed in the *Medium Minority* intervention group. In contrast, prevalence of obesity in the *Medium Minority* comparison group at pretest was similar to the pretest measurement of the *High Minority* intervention group. At posttest, the *Medium Minority* comparison group surpassed all other groups to have the highest prevalence of obesity. Clearly much work is needed in reducing childhood obesity disparities among Alabama children.

Strengths and Limitations of Study

As with any research study, strengths and limitations are present. A major strength of this study is the presentation of results of the HEAL program, using a

comparison group, that was not previously available. The study used a large, diverse sample and included objective measures of weight and cardiovascular endurance.

Limitations of the study include limited generalizability and a non-randomized study population. This study is likely not generalizable nationwide; however, the HEAL program was developed to address factors seen in the state of Alabama. A quasi-experimental design was used in this study. Although randomization provides the strongest research design, there are times when random assignment is not possible or practical. In these cases, quasi-experimental designs are the best or only alternative (Cottrell & McKenzie, 2005). In addition the review of the HEAL program would have been stronger if data from all schools were available (data from 2 schools could not be used due to apparent coding errors).

Recommendations

This section contains recommendations for practice or implementation and future research.

Recommendations for Practice or Implementation

Mixed results have been reported for school based obesity prevention interventions. In this study no improvement in weight status was observed in the intervention students in contrast to comparison students. However, since the intervention was shown to improve cardiovascular endurance and nutrition and physical activity knowledge, it may be premature to conclude that the program was unsuccessful at altering the determinants of obesity. Additionally, it is important to note that changes in weight status take a significant amount of time.

The prevalence of obesity in this sample was as high or higher than rates previously reported for Alabama children (Geiger et al., 2009, National Survey of Children's Health, 2010-2011). Owing to the high prevalence of obesity at the onset of the program, it may be difficult for a primary obesity prevention program to be successful beginning in the fifth grade. Perhaps the use of programs such as HEAL for younger children might have a greater effect in the prevention of obesity. Von Kries and colleagues (2012) also suggest that interventions that aim to prevent obesity in children at normal weight may need to be supplemented with components that target children who are already obese. It appears that future school based interventions in Alabama need to begin earlier and/or be more intense in order to produce desired results.

While schools alone cannot be responsible for reducing the obesity rates among children in Alabama, it is unlikely that obesity prevalence will decline without the involvement of schools given the influence that schools have in shaping the minds of students as well as the infrastructure already present for addressing physical activity and nutrition. Interventions must take into account health disparities that exist in the prevalence of childhood obesity. Students attending schools with high poverty and high minority populations show a much higher rate of obesity than their counterparts. Culturally appropriate materials should be available for these students.

Recommendations for Future Research

Additional research could be conducted using the same data set explored for this study. Correlational studies could be conducted to determine if BMI Z-score is correlated with specific nutrition or physical activity behaviors. Further studies could examine differences in PACER scores and knowledge and behavior scores by school and gender.

Future research should include more schools with high minority and high poverty populations, an assessment of intervention exposure, and obtain qualitative measurements. Interventions in schools with a high minority population should be tailored to the culture of the students. Seo and Sa (2010) found that culturally-tailored programs were more efficacious than those in which culture was not incorporated. A formative evaluation would need to be conducted before the program to determine if the materials are suitable and meaningful for the desired audience.

Interventions should stress self-efficacy; students should develop a confidence that they are able to complete the targeted behaviors. Guidance, goal setting, and verbal reinforcement should aid in improved self-efficacy.

Assessment of intervention exposure could be addressed through process measures that identify whether students received different portions of the intervention. Process measurements could include factors such as the frequency of heart rate monitor use, number of completed intervention lessons, and distribution of parental materials. The use of these measures may assist researchers in identifying why an intervention is successful or parts of the intervention that present problems in implementation.

Following the intervention, an impact evaluation should include or should address changes in weight status, fitness level, attitude, knowledge, and behavior. All targeted behaviors should be addressed in the evaluation.

Qualitative measurements could be obtained from PE teachers and parents. In-depth interviews with PE teachers may expose unknown barriers and/or benefits to the intervention. Parental involvement in focus groups can reveal knowledge of and attitudes

toward the program as well as providing data on the cultural norms of groups or subgroups represented.

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APPENDIX A

EFFECTIVE PUBLIC HEALTH PRACTICE PROJECT QUALITY ASSESSMENT TOOL

Effective Public Health Practice Project Quality Assessment Tool

A Selection Bias

1. Are the individuals selected to participate in the study likely to be representative of the target population?

   Very Likely
   Somewhat Likely
   Not Likely

2. What percentage of selected individuals agreed to participate?

   80 - 100% Agreement
   60 - 79% Agreement
   Less than 60% Agreement
   Not Reported
   Not Applicable

3. Rate this section (see dictionary)

   Strong
   Moderate
   Weak

B Allocation Bias

4. Indicate the study design

   RCT (go to question 5)
   Quasi-Experimental (skip to question 8)
   Case-Control (skip to question 8)
   Before/After study (skip to question 8)
   No Control Group (skip to question 8)
   Other (skip to question 8)

5. Is the method of random allocation stated?

   Yes
   No

6. If the method of random allocation is stated, is it appropriate?

   Yes
   No

7. Was the method of random allocation reported as concealed?

   Yes
   No

8. Rate this section (see dictionary)

   Strong
   Moderate
   Weak

C Confounders

9. Prior to the intervention were there between group differences for important confounders reported in the paper?

   Yes
   No
   Can't tell

10. Relevant confounders reported in the study.

11. If there were differences between groups for important confounders, were they adequately managed in the analysis?

    Yes
    No
    Not Applicable

12. Were there important confounders not reported in the paper?
    Yes
    No

13. Relevant confounders NOT reported in the study.

14. Rate this section (see dictionary)

    Strong
    Moderate
    Weak

Blinding

15. Was (were) the outcomes assessor(s) blinded to the intervention or exposure status of participants?

    Yes
    No
    Not Reported
    Not Applicable

16. Rate this section (see dictionary)

    Strong
    Moderate
    Weak
    Not Applicable

E Data Collection Methods

17. Were data collection tools shown or are they known to be valid?

    Yes
    No

18. Were data collection tools shown or are they known to be reliable?
    Yes
    No

19. Rate this section (see dictionary)
    Strong
    Moderate
    Weak

F Withdrawals and Drop-outs

20. Indicate the percentage of participants completing the study. (If the percentage differs by groups, record the lowest)

    80 - 100%
    60 - 79%
    Less than 60%
    Not Reported
    Not Applicable

21. Rate this section (see dictionary)

Strong
Moderate
Weak
Not Applicable

G Analysis

22. Is there a sample size calculation or power calculation?

Yes
Partially
No

23. Is there a statistically significant difference between groups?

Yes
No
Not Reported

24. Are the statistical methods appropriate?

Yes
No
Not Reported

25. Indicate the unit of allocation.

Community
Organization/Institution
Group
Provider
Individual

26. Indicate the unit of analysis.

Community
Organization/Institution
Group
Provider
Individual

27. If the unit of allocation and the unit of analysis are different, was the cluster analysis done?

    Yes
    No
    Not Applicable

28. Is the analysis performed by intervention allocation status (i.e. intention to treat) rather than the actual intervention received?

    Yes
    No
    Can't tell
    Not Applicable

29. Comments

H Intervention Integrity

30. What percentage of participants received the allocated intervention or exposure of interest?

    80 - 100%
    60 - 79%
    Less than 60%
    Not Reported
    Not Applicable

31. Was the consistency of the intervention measured?

    Yes
    No
    Not Reported
    Not Applicable

32. Comments

APPENDIX B

SUMMARY OF SYSTEMATIC REVIEWS

Summary of systematic reviews

First author, publication year	Search range, databases	Number of studies, study design, age of participants quality of studies	Intervention strategies	Outcome measures – weight status	Overview of results
Brown, 2009	Up to 2006, MEDLINE and EMBASE	38 studies, RCTs and CCTs, 5-18 years of age, Quality not addressed	Diet only interventions, physical activity only interventions, combined diet and physical activity interventions	BMI, BMI z-score, waist circumference, skinfold thickness, prevalence of overweight and obesity, body fat percentage	Mixed results: 1 of 3 diet studies, 5 of 15 physical activity studies, 9 of 20 combined diet and physical activity studies produced significant and positive differences between intervention and control groups for BMI. Studies were heterogeneous – making generalizations difficult. School-based physical activity interventions may assist children in maintaining a healthy weight, but results are inconsistent and short-term. Younger children and girls may benefit more from physical activity interventions.
Kropsi, 2008	Since 1990	14 studies, RCTs and CCTs, 4-14 years of age, Quality of studies addressed using criteria developed by the GRADE working group which produces a score based on methodological strengths and weaknesses	Nutrition only interventions, physical activity only interventions, combined diet and physical activity interventions,	BMI, triceps skinfold thickness, body fat percentage, waist circumference	Mixed results; One study (grade 4) showed strong evidence for reducing the odds ratio for overweight in girls only; four (grade 2) studies produced significant improvements in BMI or prevalence of overweight and obesity in boys, girls, or both. The small number of published studies meeting inclusion criteria coupled with methodological concerns limits the ability to draw conclusions about the efficacy of school-based childhood obesity programs.
Li, 2008	1990-2006	22 studies, RCTs and CCTS,	Health education, health education and physical activity, health education, physical activity and dietary	BMI, prevalence of overweight and obesity, skinfold	Mixed results: although 18 out of 22 studies reported significant and positive differences ($p < .05$) in weight status outcome measure, all studies had moderate or

First author, publication year	Search range, databases	Number of studies, study design, age of participants quality of studies	Intervention strategies	Outcome measures – weight status	Overview of results
		2-19 years of age, Quality of studies assessed using Effective Public Health Practice Project Quality Assessment Tool	interventions, Physical activity, physical activity and dietary modification	thickness	serious methodological weaknesses
Shaya, 2008	June 1986 – June 2006, PubMed and OVID Medline	51 studies, study designs not identified 7-19 years of age, quality not addressed	Implementation or modification of existing physical activity program, health or fitness educational models, dietary regimens, or physical activity behavior modification strategies, combined physical activity programs, health/fitness educational models, and/or dietary regimens physical	BMI, ponderosity indices, triceps and subscapular skinfold measurements, body fat %, waist-to-hip ratio .	Mixed results: 40 of the 51 studies showed statistically significant results in some or all quantitative measures from baseline to follow-up. There is no indication how many of the statistically significant results were observed when an outcome measure of weight was used.

APPENDIX C

COMPARISON OF STUDIES IN SYSTEMATIC REVIEWS

Comparison of studies included in systematic reviews

	Brown, 2008	Kropski, 2008	Li, 2008	Shaya, 2008
Amaro, 2006	X			X
Ask, 2006	X			
Atkinson, 2002				X
Bayne-Smith, 2004				X
Berkey, 2003				X
Bo, 1997			X	
Bonhauser, 2005				X
Burke, 1996				X
Burke, 1998				X
Bush, 1989				X
Caballero, 2003	X			X
Carrel, 2005				X
Chavarro, 2005				X
Christodoulos, 2006				X
Coleman, 2005		X		X
Connor, 1986				X
Dai, 2006			X	
Danielzik, 2007	X	X		
Donnelly, 1996	X	X		X
Duncan, 1983				X
Eliakim, 2007	X			
Fang, 2006			X	
Feng, 2004			X	
Feng, 2005			X	
Flores, 1995	X			X
Fu, 2006			X	
Gans, 1990				X
Gortmaker, 1999	X			X
Graf, 2005	X			
Grey, 2004				
Haerens, 2006	X			
Harrell, 1996				X
Harrell, 1998				X
Harrell, 2005				X
Harrison, 2006	X			
Hawley, 2006				X
He, 2004			X	
Hopper, 1992				X
Hsu, 2004				X
Huang, 2005			X	
Huang, 2007				
James, 2004	X			
Jamner, 2004	X			X
Jiang, 2002			X	
Jiang, 2006			X	

	Brown, 2008	Kropski, 2008	Li, 2008	Shaya, 2008
Jiang, 2007			X	
Jin, 2004			X	
Kafatos, 2005				X
Kain, 2004	X	X		X
Killen, 1988				X
Kimm, 2005				X
Lazaar, 2007	X			
Li, 1999			X	
Linden, 2006	X			
Lobstein, 2004				
Luepker, 1996	X			
Ma, 2003			X	
Manios, 1998	X			X
Manois, 1999	X			
Manois, 2002	X			
McKenzie, 2001				X
McMurray, 2002				X
Mo-suwan, 1998	X			
Muller, 2001		X		
Neumark-Sztainer, 2003				
Pangrazi, 2003	X			X
Paradis, 2005				X
Pate, 2005	X			
Resnicow, 1993				X
Robbins, 2006	X			
Robinson, 1999	X			
Robinson, 2003	X			
Rodgers, 2001				X
Rosenbaum, 2007	X			
Rowland, 1995				X
Sahota, 2001	X	X		X
Sallis, 1993	X			
Sallis, 1997	X			X
Sallis, 2003	X	X		
Schofield, 2005	X			
Seo, 2005				X
Shi, 2002			X	
Simon, 2006				X
Singh, 2007	X			
Spiegel, 2006	X			X
Stephens, 1998	X			X
Stewart, 1995				X
Sun, 2005			X	
Suzuki, 1993				X
Taylor, 2007	X			
Tian, 2006			X	
Trevino, 2004	X			

	Brown, 2008	Kropski, 2008	Li, 2008	Shaya, 2008
Trevino, 2005	X			
Trudeau, 2000	X			
Trudeau, 2001	X			
Valdimarsson, 2006	X			
VanDongen, 1995	X	X		X
Viskic-Stalec, 2007	X			
Walter, 1986				X
Walter, 1988				X
Wang, 2005			X	
Warren, 2003	X	X		
Watts, 2005				
Williamson, 2007	X			
Wilson, 2005				X
Yang, 2005			X	
Yin, 2005				X
Zahner, 2006				X
Zang, 2005			X	
Zhang, 2004			X	
Zhang, 2005			X	
Zhang, 2006			X	

APPENDIX D

SUMMARY OF META-ANALYSES

First author, publication year	Search range, databases	Number of studies, study design, age of participants, quality of studies	Intervention strategies	Outcome measures – weight status	Overview of results
Cook-Cottone, 2009	January 1997-July 2008, Medline, PsychInfo, CINAHL, Academic Search Premier, Cochrane Database of Systematic Reviews and reference lists	40 studies with 66 comparisons, RTCs and CCTs, Preschool – 12th grade	Nutrition only, physical activity only, nutrition and physical activity interventions	BMI, BMI z-score, rate of overweight and obesity, triceps skinfold	38% of studies produced significant findings in weight gain prevention. Universal interventions proved more effective than interventions where participants were selected based on weight status. Interventions targeting elementary age children were more significant than those aimed at middle school children. No effect was seen in interventions targeting high school students. Studies targeting Asian students and predominately white students produced significant and positive effects. One intervention with Native American children showed a small positive effect. No significant effects were found in interventions aimed at African-American or Hispanic students. Positive and significant effects were reported for low/moderate, moderate, and long programs while programs with a short duration were observed to have significant and negative effects. Interventions encouraging health eating were significantly more effective than those with system-wide nutritional changes. Positive and significant effects were seen among interventions that included increased or enhanced physical activity. Programs aimed at decreasing sedentary behaviors

First author, publication year	Search range, databases	Number of studies, study design, age of participants, quality of studies	Intervention strategies	Outcome measures – weight status	Overview of results
					were more effective than those that did not.
Gonzalez-Suarez, 2009	1995-2007, Medline, PsychInfo, Embase, EMB reviews, Cochrane Library, CINAHL, Current Contents, BioMed Central, AusHealth, SCOPUS, TRIP, Science Direct, AMED, PubMed and Academic Elite and reference lists	19 articles, RTCs and CCTs, Preadolescent and adolescent school children, Methodological quality assessed using Joanna Briggs Institute Critical Appraisal of Evidence Effectiveness tool	Nutrition only, physical activity only, and combination interventions	BMI, waist girth, body fat percentage and triceps skinfold	Evidence appears convincing that school-based obesity prevention programs are effective, at least in the short-term, in reducing childhood obesity prevalence. Programs with longer duration were more effective than shorter ones.
Kanekar, 2008	2000-2007 Medline and CINAHL	5 studies included in meta-analysis, Elementary – high school age children, Quality assessment completed using population sample size, design (quasi-experimental or	Nutrition only, physical activity only, nutrition and physical activity combination intervention	BMI	Results were not significant for BMI outcome measure

First author, publication year	Search range, databases	Number of studies, study design, age of participants, quality of studies	Intervention strategies	Outcome measures – weight status	Overview of results
		experimental), type and duration of intervention, post-intervention follow-up protocol, outcome measures			
Katz, 2008	1966-October 2004, MEDLINE, HealthStar, PsychInfo, Embase and February 2000 – October 2004, Medline, Ovid, CINAHL, PsychInfo	21 articles describing 19 studies included in systematic review; 8 studies used in meta-analysis, Quality assessed using CDC's Community Guide data abstraction form	8 studies used in meta-analysis utilized a combination of physical activity and nutrition interventions	BMI, percentage of students overweight or obese, skinfold measures, ponderosity index, body weight, body fat percentage, central adiposity,	Nutrition and physical activity combination interventions appear effective in producing weight reduction in school settings

APPENDIX E

JBI (JOANNA BRIGGS INSTITUTE) CRITICAL APPRAISAL CHECKLIST FOR SYSTEMATIC REVIEWS

JBI Critical Appraisal Checklist for Systematic Reviews

Reviewer _____ Date _____
Author _____ Year _____ Record Number _____

		Yes	No	Unclear
1.	Is the review question clearly and explicitly stated?	☐	☐	☐
2.	Was the search strategy appropriate?	☐	☐	☐
3.	Were the sources of studies adequate?	☐	☐	☐
4.	Were the inclusion criteria appropriate for the research question?	☐	☐	☐
5.	Were the criteria for appraising studies appropriate?	☐	☐	☐
6.	Was critical appraisal conducted by two or more reviewers independently?	☐	☐	☐
7.	Were there methods used to minimize error in data extraction?	☐	☐	☐
8.	Were the methods used to combine studies appropriate?	☐	☐	☐
9.	Were the recommendations supported by the reported data?	☐	☐	☐
10.	Were the specific directives for new research appropriate?	☐	☐	☐

Overall Appraisal: Include ☐ Exclude ☐ Seek further info. ☐

Comments (Including reasons for exclusion): _____

_____

_____

APPENDIX F

STUDIES USED IN META-ANALYSES

	Cook-Cottone et al., 2009	Gonzalez-Suarez et al., 2009	Kanekar & Sharma, 2009	Katz et al., 2008
Amaro et al., 2006	X			
Bayne-Smith et al., 2004	X			
Caballero et al., 2003	X		X	
Carrel et al., 2005		X		
Coleman et al., 2005		X		
Damon et al., 2005	X			
Danielzik et al., 2007		X		
Economos et al., 2007	X			
Edwards, 2005	X			
Eliakim et al., 2007	X			
Foster et al., 2008	X			
Goran & Reynolds, 2005	X			
Gortmaker et al., 1999	X			
Graf et al., 2005		X		
Grey et al., 2004		X		X
Haerens et al., 2006	X			
Harrell et al., 1996		X		
Harrell et al., 1998	X			
Harrell et al, 2005			X	
Huang et al., 2007		X		
James et al., 2004	X	X	X	
Jamner et al., 2004	X			
Jiang et al., 2007	X	X		
Kafatos et al., 2007		X		
Kain et al., 2004	X	X		X
Kipping et al., 2008	X			
Lazaar et al., 2007		X		
Lionis et al., 1991				X
Lobstein et al., 2004		X		
Lohman et al., 2003				X
Liu et al., 2008	X			
Manios et al., 1999	X	X		
Manois et al., 2002		X		
McMurray et al., 2002	X			
Mo-suwan et al., 1998	X			
Nader et al., 1999	X			X
Neumark-Sztainer et al., 2003	X		X	X
Pangrazi et al., 2003	X			
Perman et al., 2008	X			
Robinson, 1999	X	X		
Robinson et al. 2003			X	
Sadowsky et al., 1999	X			

	Cook-Cottone et al., 2009	Gonzalez-Suarez et al., 2009	Kanekar & Sharma, 2009	Katz et al., 2008
Sahota et al., 2001	X			
Sallis et al., 1997	X			
Salmon et al., 2008	X			
Singh et al., 2007	X			
Skybo & Ryan-Wenger, 2002	X			X
Spiegel et al, 2004		X		
Spiegel & Foulk, 2006	X			
Stewart et al., 1997	X			
Stock et al., 2007	X			
Story et al., 2003	X			
Tamir et al., 1990				X
Taylor et al., 2007	X			
Vizcaino et al., 2008	X			
Walter et al., 1988				X
Watts et al., 2005		X		
Williamson et al., 2007	X			
Yin et al., 2005	X	X		

APPENDIX G

IRB APPROVAL FORM

THE UNIVERSITY OF ALABAMA AT BIRMINGHAM

Institutional Review Board for Human Use

Form 4: IRB Approval Form
Identification and Certification of Research
Projects Involving Human Subjects

UAB's Institutional Review Boards for Human Use (IRBs) have an approved Federalwide Assurance with the Office for Human Research Protections (OHRP). The Assurance number is FWA00005960 and it expires on January 24, 2017. The UAB IRBs are also in compliance with 21 CFR Parts 50 and 56.

Principal Investigator: DEVANE-HART, KELLEY R

Co-Investigator(s):

Protocol Number: **X120725003**

Protocol Title: *Using a Secondary Data Analysis to Explore the Efficacy of a Physical Education Curriculum*

The IRB reviewed and approved the above named project on 12-10-13. The review was conducted in accordance with UAB's Assurance of Compliance approved by the Department of Health and Human Services. This Project will be subject to Annual continuing review as provided in that Assurance.

This project received EXPEDITED review.

IRB Approval Date: 12-10-13

Date IRB Approval Issued: 12-10-13

IRB Approval No Longer Valid On: 12-10-14

Marilyn Doss

Marilyn Doss, M.A.
Vice Chair of the Institutional Review
Board for Human Use (IRB)

Investigators please note:

The IRB approved consent form used in the study must contain the IRB approval date and expiration date.

IRB approval is given for one year unless otherwise noted. For projects subject to annual review research activities may not continue past the one year anniversary of the IRB approval date.

Any modifications in the study methodology, protocol and/or consent form must be submitted for review and approval to the IRB prior to implementation.

Adverse Events and/or unanticipated risks to subjects or others at UAB or other participating institutions must be reported promptly to the IRB.

APPENDIX H

PROCEDURE FOR SELECTION OF CLASSES FOR DATA COLLECTION

Procedure for Selecting Classes for Data Collection

Items needed to determine classes for data collection:

Alphabetical list of teachers in each school
Total number of 5th grade students in each school
Number of 5th grade classes in each school

1. For schools with less than 40 total 5th grade students, data on all students will be collected.

2. For schools with 40 5th grade students or more, multiply the total number of 5th grade students by 0.40 (40%). This is the minimum number of 5th grade students from which data will be collected.

   *Example: For a school with 130 students, data collection would be needed from a minimum of (130 students * 0.40) = 32.5, or 33 students.*

3. Determine how many classes will be needed to gather data from the minimum number of 5th grade students.

   Example: Assuming that all classes have the same number of students, in a school with 130 students in 5 classes, it will take data collection from 2 classes to ensure the minimum number of students.

   (130 total students/5 classes = 26 students per class; in order to collect data on a minimum of 33 students, two classes will be required)

4. After determining the minimum number of classes needed for data collection, select the classes to be used by identifying the predetermined randomly selected classes from using an alphabetical list of the 5th grade teachers.

   Numbers were randomly selected using a random integer set generator at www.random.org.

   For schools with 3 (three) 5th grade classes: Choose the 1st and 3rd classes

   For schools with 4 (four) 5th grade classes: Choose the 2nd and 4th classes

   For schools with 5 (five) 5th grade classes: Choose the 3rd and 5th classes

   For schools with 6 (six) 5th grade classes: Choose the 1st, 4th and 5th classes

   For schools with 7 (seven) 5th grade classes: Choose the 2nd, 6th, and 7th classes

   For schools with 8 (eight) 5th grade classes: Choose the 1st, 3rd, 6th, and 8th classes

HEAL Data Collection

School ID	Number of 5th Grade Classes	Classes to Choose for Data Collection (from alphabetized list of teachers)
101	2	All
103	8	1st, 3rd, 6th, and 8th
104	6	1st, 4th, and 5th
105	5	3rd and 5th
106	2	All
107	5	3rd and 5th
108	4	2nd and 4th
109	1	All
201	5	3rd and 5th
202	3	1st and 3rd
204	5	3rd and 5th
205	4	2nd and 4th
206	3	1st and 3rd

APPENDIX I

BMI Z-SCORE TABLES FOR BOYS

BMI Z-Score Tables for Boys

Age in Months	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2
120	13.83455	14.36908	14.99097	15.72839	16.62455	17.74998	19.23038	21.31984	24.64763
120.5	13.84565	14.3821	15.00628	15.7465	16.64614	17.77608	19.26261	21.36099	24.70335
121	13.8569	14.39527	15.02174	15.76474	16.66786	17.8023	19.29492	21.40215	24.75891
121.5	13.8683	14.40859	15.03734	15.78313	16.68972	17.82863	19.32731	21.44333	24.81432
122	13.87985	14.42205	15.05309	15.80165	16.7117	17.85508	19.35979	21.48453	24.86957
122.5	13.89154	14.43566	15.06898	15.8203	16.73381	17.88164	19.39235	21.52574	24.92465
123	13.90338	14.44941	15.08501	15.8391	16.75604	17.9083	19.42498	21.56696	24.97957
123.5	13.91536	14.46331	15.10118	15.85803	16.7784	17.93508	19.45769	21.60819	25.03432
124	13.92749	14.47735	15.11749	15.87709	16.80089	17.96196	19.49047	21.64942	25.0889
124.5	13.93977	14.49153	15.13393	15.89628	16.8235	17.98894	19.52333	21.69065	25.14329
125	13.95219	14.50586	15.15052	15.91561	16.84622	18.01603	19.55625	21.73188	25.19751
125.5	13.96476	14.52032	15.16725	15.93507	16.86907	18.04322	19.58924	21.77311	25.25154
126	13.97747	14.53493	15.18411	15.95466	16.89204	18.07051	19.6223	21.81433	25.30539
126.5	13.99032	14.54968	15.20111	15.97438	16.91512	18.0979	19.65541	21.85554	25.35904
127	14.00332	14.56457	15.21824	15.99422	16.93833	18.12538	19.68859	21.89673	25.41249
127.5	14.01646	14.5796	15.23551	16.01419	16.96164	18.15296	19.72183	21.93792	25.46575
128	14.02974	14.59477	15.25291	16.03429	16.98507	18.18063	19.75513	21.97909	25.51881
128.5	14.04316	14.61007	15.27044	16.05451	17.00862	18.2084	19.78848	22.02024	25.57166
129	14.05672	14.62551	15.28811	16.07486	17.03227	18.23626	19.82188	22.06137	25.62432
129.5	14.07042	14.64109	15.30591	16.09533	17.05604	18.2642	19.85534	22.10247	25.67675
130	14.08427	14.6568	15.32383	16.11593	17.07991	18.29224	19.88885	22.14355	25.72898
130.5	14.09825	14.67265	15.34189	16.13664	17.1039	18.32036	19.9224	22.1846	25.78099
131	14.11236	14.68863	15.36008	16.15747	17.12799	18.34856	19.956	22.22562	25.83278
131.5	14.12662	14.70475	15.37839	16.17843	17.15218	18.37685	19.98965	22.2666	25.88435
132	14.14101	14.721	15.39683	16.1995	17.17648	18.40522	20.02334	22.30755	25.9357
132.5	14.15554	14.73738	15.4154	16.22069	17.20089	18.43368	20.05707	22.34847	25.98682
133	14.1702	14.75389	15.43409	16.24199	17.22539	18.46221	20.09084	22.38934	26.03771
133.5	14.185	14.77054	15.4529	16.26341	17.25	18.49082	20.12465	22.43017	26.08837
134	14.19993	14.78731	15.47184	16.28495	17.27471	18.51951	20.15849	22.47096	26.1388
134.5	14.21499	14.80421	15.49091	16.3066	17.29951	18.54827	20.19237	22.51171	26.189
135	14.23019	14.82124	15.51009	16.32836	17.32442	18.57711	20.22628	22.5524	26.23895
135.5	14.24552	14.83839	15.52939	16.35023	17.34942	18.60601	20.26022	22.59305	26.28867
136	14.26098	14.85568	15.54882	16.37221	17.37451	18.635	20.29419	22.63364	26.33814
136.5	14.27657	14.87308	15.56836	16.3943	17.3997	18.66405	20.32819	22.67418	26.38737
137	14.29229	14.89062	15.58802	16.4165	17.42499	18.69317	20.36222	22.71467	26.43636
137.5	14.30813	14.90827	15.6078	16.43881	17.45036	18.72235	20.39627	22.7551	26.48509
138	14.32411	14.92605	15.6277	16.46122	17.47583	18.7516	20.43034	22.79546	26.53358
138.5	14.34021	14.94396	15.64771	16.48374	17.50138	18.78092	20.46444	22.83577	26.58182

Age in Months	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2
139	14.35644	14.96198	15.66783	16.50636	17.52703	18.8103	20.49855	22.87602	26.6298
139.5	14.37279	14.98012	15.68807	16.52908	17.55276	18.83975	20.53269	22.9162	26.67753
140	14.38927	14.99839	15.70842	16.55191	17.57857	18.86925	20.56684	22.95631	26.725
140.5	14.40587	15.01677	15.72888	16.57484	17.60448	18.89881	20.60101	22.99636	26.77222
141	14.4226	15.03527	15.74946	16.59787	17.63046	18.92844	20.63519	23.03633	26.81917
141.5	14.43944	15.05388	15.77014	16.62099	17.65653	18.95811	20.66939	23.07624	26.86587
142	14.45641	15.07262	15.79093	16.64422	17.68269	18.98785	20.70359	23.11607	26.9123
142.5	14.4735	15.09147	15.81183	16.66754	17.70892	19.01764	20.73781	23.15583	26.95847
143	14.49071	15.11043	15.83283	16.69096	17.73523	19.04748	20.77204	23.19552	27.00438
143.5	14.50803	15.1295	15.85395	16.71447	17.76162	19.07738	20.80627	23.23512	27.05002
144	14.52547	15.14869	15.87516	16.73808	17.78809	19.10733	20.84051	23.27465	27.0954

APPENDIX J

BMI Z-SCORE TABLES FOR GIRLS

BMI Z-Score Tables for Girls

Age in Months	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2
120	13.58697	14.21204	14.93873	15.79839	16.83795	18.13158	19.80519	22.09499	25.51489
120.5	13.59916	14.22648	14.95585	15.81875	16.86231	18.16103	19.84133	22.14036	25.57383
121	13.61148	14.24105	14.97308	15.83921	16.88676	18.19054	19.87751	22.18572	25.63271
121.5	13.62394	14.25574	14.99043	15.85977	16.9113	18.22012	19.91373	22.23108	25.69153
122	13.63655	14.27057	15.0079	15.88044	16.93592	18.24976	19.94997	22.27644	25.7503
122.5	13.64929	14.28552	15.02548	15.90121	16.96062	18.27946	19.98625	22.32179	25.809
123	13.66216	14.3006	15.04318	15.92207	16.9854	18.30922	20.02256	22.36712	25.86764
123.5	13.67517	14.3158	15.06099	15.94303	17.01026	18.33903	20.05889	22.41245	25.92621
124	13.68832	14.33113	15.07891	15.96409	17.0352	18.3689	20.09524	22.45775	25.98471
124.5	13.7016	14.34658	15.09694	15.98524	17.06021	18.39882	20.13161	22.50303	26.04314
125	13.71501	14.36215	15.11507	16.00648	17.0853	18.42878	20.168	22.54829	26.10149
125.5	13.72856	14.37784	15.13332	16.02782	17.11045	18.45879	20.2044	22.59353	26.15977
126	13.74224	14.39365	15.15167	16.04924	17.13568	18.48885	20.24082	22.63873	26.21796
126.5	13.75604	14.40958	15.17012	16.07075	17.16097	18.51894	20.27724	22.68391	26.27606
127	13.76998	14.42563	15.18868	16.09235	17.18632	18.54908	20.31368	22.72905	26.33408
127.5	13.78405	14.44179	15.20734	16.11403	17.21174	18.57925	20.35011	22.77415	26.39202
128	13.79824	14.45807	15.2261	16.1358	17.23723	18.60946	20.38655	22.81921	26.44985
128.5	13.81256	14.47447	15.24496	16.15764	17.26277	18.6397	20.42299	22.86423	26.5076
129	13.82701	14.49097	15.26392	16.17957	17.28837	18.66998	20.45943	22.9092	26.56525
129.5	13.84158	14.50759	15.28298	16.20158	17.31403	18.70028	20.49587	22.95413	26.6228
130	13.85627	14.52432	15.30213	16.22366	17.33974	18.73061	20.53229	22.99901	26.68024
130.5	13.87109	14.54116	15.32138	16.24582	17.36551	18.76097	20.56871	23.04383	26.73759
131	13.88603	14.55811	15.34071	16.26805	17.39132	18.79135	20.60511	23.0886	26.79482
131.5	13.90109	14.57517	15.36014	16.29036	17.41719	18.82175	20.6415	23.13331	26.85195
132	13.91627	14.59233	15.37966	16.31274	17.44311	18.85217	20.67788	23.17796	26.90897
132.5	13.93157	14.6096	15.39927	16.33518	17.46907	18.88261	20.71423	23.22255	26.96588
133	13.94699	14.62697	15.41897	16.3577	17.49507	18.91306	20.75057	23.26707	27.02267
133.5	13.96253	14.64444	15.43876	16.38028	17.52112	18.94353	20.78688	23.31153	27.07935
134	13.97818	14.66202	15.45862	16.40293	17.54721	18.974	20.82317	23.35591	27.13591
134.5	13.99394	14.6797	15.47858	16.42564	17.57333	19.00449	20.85943	23.40023	27.19235
135	14.00982	14.69747	15.49861	16.44841	17.5995	19.03498	20.89566	23.44447	27.24866
135.5	14.02582	14.71535	15.51873	16.47124	17.6257	19.06548	20.93186	23.48863	27.30486
136	14.04192	14.73332	15.53892	16.49413	17.65193	19.09599	20.96802	23.53272	27.36092
136.5	14.05813	14.75139	15.55919	16.51708	17.6782	19.12649	21.00415	23.57673	27.41686
137	14.07446	14.76955	15.57954	16.54008	17.7045	19.157	21.04025	23.62065	27.47267
137.5	14.09089	14.7878	15.59997	16.56314	17.73082	19.1875	21.0763	23.66449	27.52835
138	14.10743	14.80615	15.62047	16.58625	17.75718	19.218	21.11231	23.70824	27.5839

Age in Months	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2
138.5	14.12407	14.82459	15.64104	16.60942	17.78356	19.24849	21.14827	23.7519	27.63931
139	14.14082	14.84312	15.66169	16.63263	17.80996	19.27897	21.18419	23.79547	27.69459
139.5	14.15768	14.86173	15.6824	16.65589	17.83638	19.30945	21.22007	23.83895	27.74973
140	14.17464	14.88043	15.70318	16.6792	17.86283	19.33991	21.25589	23.88233	27.80473
140.5	14.19169	14.89922	15.72403	16.70255	17.88929	19.37037	21.29166	23.92562	27.85959
141	14.20885	14.9181	15.74495	16.72595	17.91577	19.4008	21.32738	23.96881	27.91432
141.5	14.22611	14.93705	15.76593	16.74938	17.94227	19.43122	21.36304	24.01189	27.9689
142	14.24346	14.95609	15.78697	16.77286	17.96878	19.46162	21.39865	24.05488	28.02333
142.5	14.26091	14.97521	15.80808	16.79638	17.99531	19.492	21.43419	24.09776	28.07762
143	14.27846	14.9944	15.82924	16.81994	18.02184	19.52236	21.46968	24.14054	28.13177
143.5	14.2961	15.01368	15.85046	16.84353	18.04838	19.5527	21.5051	24.18321	28.18577
144	14.31383	15.03303	15.87174	16.86716	18.07493	19.58301	21.54046	24.22577	28.23962

APPENDIX K

PROCEDURES FOR COLLECTING HEIGHT AND WEIGHT MEASUREMENTS

Procedure for Collecting Height and Weight Measurements

Personnel and materials needed for height and weight measurements:

A minimum of two (2) qualified data collectors
List of classrooms, by teacher, for data collection (these classes were determined using the *Procedure for selecting classes for data collection*)
2 copies of class roll of classrooms that were selected for data collection
Charder HM-2000P Portstad stadiometer
Tanita Model BF-522W scale
Spare AA batteries (4 spare batteries)
2 Clipboards
Pens or pencils
Masking tape

Procedures for setting up prior to data collection

1. Upon entering gym, or other data collection site, determine location to set up stadiometer and scales.
    a. **Stadiometer** – the stadiometer must be placed on a level floor against a wall in an area of low traffic.
    b. **Scales** – the scales must be placed on a level floor in an office or in another area where student privacy can be assured. If it is impossible to weigh tudents in an office, use masking tape to create a line on the floor. Students will be asked to remain behind the line while a classmate is being weighed. The masking tape line should allow for a minimum of six (6) feet between the student being weighed and the next student.
2. Set up stadiometer, using rest pieces against the wall to stabilize the device.
3. Set up scales, placing the display box on a desk or table.
4. Place copies of class rolls in order for data collection.

Procedure for collecting height and weight measures

1. Data collector #1 will call the first class for data collection. When the first class arrives, Data collector #1 instructs students to get in line in alphabetical order. *(If students are unable to do this without assistance, Data collector #1 will call out names to allow students to get in alphabetical order).*
2. Students are asked to remove shoes, jackets, and any other items which may alter height and weight measurements such as sweatshirts, belts with heavy buckles, and hair accessories on the top of the head.
3. In alphabetical order, students will have their height measured by Data collector #1 then will have weight measured by data collector #2.
    a. **Measuring height –**
        i. Data collector #1 will ask the student to:
            1. Stand with heels and upper back against the stadiometer
            2. Look straight ahead
            3. Allow arms to hang in a relaxed position at the sides of the body

ii. Data collector #1 will pull the moveable headboard down to the uppermost portion of the head.
iii. Data collector #1 will record height measurement to the nearest 0.5 cm.
iv. When appropriate, data collector #1 will ask student to move on to scale for weight measurement. The student should not leave the height measurement area until data collector #2 indicates that the scale has zeroed out the weight of the previous student.

b. **Measuring weight** –
i. Data collector #2 will ask student to step on scale when the display box reads 0.0.
ii. Student will remain on scale until the weight reading is stable.
iii. Data collector #2 will record the student's weight to the nearest 0.1 pound. **Data collector #2 will not react to the student's weight. If the student asks anything about the weight measurement, communication should remain neutral. The data collector must not state the student's weight aloud.**
iv. The student will be instructed to put shoes back on and return to class.
v. The next student may move to the scales once the previous student's weight has been erased.
vi. **Students must not be allowed to see the weight measurements of his or her classmates. Data collector #2 must make sure that the record of weights remains in an area that cannot be seen by classmates.**

<u>Procedures for finalizing data collection</u>

1. Data collectors #1 and #2 will submit height and weight measurements to HEAL personnel for data entry. The data will be maintained securely.
2. Disassemble stadiometer and pack in case.
3. Pack scales in case.

APPENDIX L

HEAL SURVEY TOOL

HEAL Survey

Name:_____School:_____

Classroom Teacher:_____Physical Education Teacher:_____

Instructions: For questions 1-24, choose the best answer for each question and fill in the circle.

1. Are you…?
   - O a boy
   - O a girl

2. During the past week, how many days did you eat breakfast?
   - O Never
   - O 1-2 days
   - O 3-4 days
   - O 5-6 days
   - O Every day

3. In the past week, how many times did you eat something from a fast food restaurant (like McDonald's, Burger King, Hardee's, Taco Bell, KFC, Chic-Fil-A etc.)?
   - O Never
   - O 1-2 times
   - O 3-4 times
   - O 5-6 times
   - O 7 times
   - O More than 7 times

4. During the past week, how often did you snack while watching TV?
   - O Never
   - O Rarely
   - O Sometimes
   - O Usually
   - O Always

5. During the past week, how often did you watch TV while eating dinner (or supper)?
   - O Never
   - O 1-2 times
   - O 3-4 times
   - O 5-6 times
   - O Every time

6. During the past week, how many times did your family eat a meal together?

O Never
O 1-2 times
O 3-4 times
O 5-6 times
O 7 times
O More than 7 times

7. For each of the following, which food do you think is healthier? If you don't know, choose Don't know. (Choose only one answer for each row)

a.	O	Pretzels	**OR**	O	Potato chips	**OR**	O	Don't know
b.	O	Whole milk (sweet milk)	**OR**	O	Skim milk	**OR**	O	Don't know
c.	O	Whole wheat bread	**OR**	O	White bread	**OR**	O	Don't know
d.	O	Fruit drink	**OR**	O	100% Fruit juice	**OR**	O	Don't know
e.	O	Frozen yogurt	**OR**	O	Ice cream	**OR**	O	Don't know

8. How often are the following true?

		Never	**Sometimes**	**Usually**	**Always**
a.	Fruits are available in my home	O	O	O	O
b.	Vegetables are served at dinner in my home	O	O	O	O
c.	Milk is served at meals in my home	O	O	O	O
d.	Potato chips or other salty snack foods are available in my home	O	O	O	O
e.	Chocolate, cookies or other sweet snacks are available in my home	O	O	O	O
f.	Soda is available in my home	O	O	O	O

9. How important is it to you to:

		Not at all	A little bit	Somewhat	Very much
a.	Eat healthy food?	O	O	O	O
b.	Stay fit and exercise?	O	O	O	O

10. Do you think that you can do the following each day?

		I don't think I can	I can some of the time	I can most of the time	I can all of the time
a.	Eat at least 2 fruit servings per day	O	O	O	O
b.	Eat at least 3 vegetable servings per day	O	O	O	O
c.	Eat at least 3 servings of dairy each day (like milk, cheese, yogurt)	O	O	O	O
d.	Eat at least 3 servings of whole grains each day (like dark bread, oatmeal, brown rice, and whole grain cereals like Cheerios)	O	O	O	O
e.	Limit soda to one or less per day	O	O	O	O
f.	Limit eating at fast food restaurants to once per week or less	O	O	O	O

11. How often are the following true?

		Never	Sometimes	Usually	Always
a.	I get 30 minutes of physical activity after school.	O	O	O	O
b.	I participate on a sports team.	O	O	O	O
c.	I am very active during my PE class.	O	O	O	O
d.	I would rather be outside playing than inside watching TV or playing video games.	O	O	O	O
e.	I enjoy doing activities that cause my heart to beat faster like playing sports, jumping rope, or swimming.	O	O	O	O
f.	I walk up stairs rather than taking the elevator or escalator.	O	O	O	O

12. How many hours do you spend each day watching TV or playing video or computer games?

O More than 6 hours
O 4-6 hours
O 2-4 hours
O Less than 2 hours

13. How many servings of fruits and vegetables should you eat each day?

O More than 6 servings
O At least 5 servings
O 2-3 servings
O Not more than 1 serving

14. What vitamins are found in fruits and vegetables?
    - O Vitamin A and Vitamin C
    - O Vitamin D and Vitamin E
    - O Vitamin E and Vitamin K
    - O Vitamin B_{12} and Vitamin D

15. Whole grains are healthier than refined grains because they:
    - O have more protein for building strong muscles.
    - O have more calcium and Vitamin D for healthy bones.
    - O have more fiber, vitamins, and minerals.
    - O have more calories.

16. A Healthy Heart Zone (HHZ) is the heart rate level that is best for you:
    - O when you are sleeping.
    - O while you are studying or in class.
    - O when you playing video games or watching television.
    - O when you are exercising to become healthy and fit.

17. How many servings of milk and dairy (like milk, cheese, and yogurt) should a fifth grader have each day?
    - O 1 serving
    - O 2 servings
    - O 3 servings
    - O 4 servings

18. How many minutes of moderate to vigorous activity should a fifth grade student get each day?
    - O 10 minutes
    - O 20 minutes
    - O 40 minutes
    - O 60 minutes

19. The Healthy Heart Zone (HHZ) for fifth grade students is:
    - O 60-80 beats per minute.
    - O 90-110 beats per minute.
    - O 140-170 beats per minute.
    - O 180-200 beats per minute.

20. Gatorade/sports drinks
    - O should be drunk all the time.
    - O should be drunk only during exercise that causes you to sweat.
    - O should never be drunk.

21. Milk and dairy (like milk, cheese and yogurt) are important because they:
- O have fiber.
- O provide calcium to make your bones and teeth strong.
- O have nutrients that help fight infections.
- O have fat which keeps your skin healthy.

22. Which of the following is NOT in the grain group?
- O Corn bread
- O Spaghetti noodles
- O French fries
- O Crackers

23. When eating fruits and vegetables you should try to:
- O eat only one color of fruit or vegetable each day.
- O eat a rainbow of colors every day.
- O eat only dark green fruits and vegetables.
- O eat only fruit.

24. Meat and beans are important because they provide protein which:
- O helps keep skin healthy.
- O helps with seeing in the dark.
- O helps to build strong muscles.
- O helps make bones and teeth strong.

25. Circle your **3** most favorite activities from the following list:

Gymnastics Football Dance Basketball Swimming

Video games Soccer Softball Baseball Tennis

Riding my bike Reading Computer games Watching TV

Texting

APPENDIX M

NUTRITION KNOWLEDGE QUESTIONS IN HEAL SURVEY

Question asked	Options provided (correct answer in bold print)	Score assigned
Which food is healthier? If you don't know, choose Don't know.	• **Pretzels** OR • Potato chips OR • Don't know	• 1 • 0 • 0
Which food is healthier? If you don't know, choose Don't know.	• Whole milk (sweet milk) OR • **Skim milk** OR • Don't know	• 0 • 1 • 0
Which food is healthier? If you don't know, choose Don't know.	• **Whole wheat bread** OR • White bread OR • Don't know	• 1 • 0 • 0
Which food is healthier? If you don't know, choose Don't know.	• Fruit drink OR • **100% Fruit juice** OR • Don't know	• 0 • 1 • 0
Which food is healthier? If you don't know, choose Don't know.	• **Frozen yogurt** OR • Ice cream OR • Don't know	• 1 • 0 • 0
How many servings of fruits and vegetables should you eat each day?	• More than 6 servings • **At least 5 servings** • 2-3 servings • Not more than 1 serving	• 0 • 1 • 0 • 0
What vitamins are found in fruits and vegetables?	• **Vitamin A and Vitamin C** • Vitamin D and Vitamin E • Vitamin E and Vitamin K • Vitamin B_{12} and Vitamin D	• 1 • 0 • 0 • 0
Whole grains are healthier than refined grains because they:	• They have more protein for building strong muscles. • Have more calcium and Vitamin D for healthy bones. • **Have more fiber, vitamins, and minerals.** • Have more calories.	• 0 • 0 • 1 • 0
How many servings of milk and dairy (like milk, cheese, and yogurt) should a fifth grader have each day?	• 1 serving • 2 servings • 3 servings • **4 servings**	• 0 • 0 • 0 • 1

Question asked	Options provided (correct answer in bold print)	Score assigned
Gatorade/sports drinks:	• Should be drunk all the time. • **Should be drunk only during exercise that causes you to sweat.** • Should never be drunk.	• 0 • 1 • 0
Milk and dairy (like milk, cheese, and yogurt) are important because they:	• Have fiber. • **Provide calcium to make your bones and teeth strong.** • Have nutrients that help fight infections. • Have fat which keeps your skin healthy.	• 0 • 1 • 0 • 0
Which of the following is NOT in the grain group?	• Cornbread • Spaghetti noodles • **French fries** • Crackers	• 0 • 0 • 1 • 0
When eating fruits and vegetables you should try to:	• Eat only one color of fruit or vegetable each day. • **Eat a rainbow of colors every day.** • Eat only dark green fruits and vegetables. • Eat only fruit.	• 0 • 1 • 0 • 0
Meat and beans are important because they provide protein which:	• helps keep skin healthy. • helps with seeing in the dark. • **helps to build strong muscles.** • helps make bones and teeth strong.	• 0 • 0 • 1 • 0

APPENDIX N

PHYSICAL ACTIVITY KNOWLEDGE QUESTIONS IN HEAL SURVEY

Question asked	Options provided (correct answer in bold print)	Score assigned
A Healthy Heart Zone (HHZ) is the heart rate level that is best for you:	• When you are sleeping. • While you are studying or in class. • When you are playing video games or watching television. • **When you are exercising to become healthy and fit.**	• 0 • 0 • 0 • 1
How many minutes of moderate to vigorous activity should a fifth grade student get each day?	• 10 minutes • 20 minutes • 40 minutes • **60 minutes**	• 0 • 0 • 0 • 1
The Healthy Heart Zone (HHZ) for fifth grade students is:	• 60-80 beats per minute. • 90-110 beats per minute. • **140-170 beats per minute.** • 180-200 beats per minute.	• 0 • 0 • 1 • 0

APPENDIX O

NUTRITION BEHAVIOR QUESTIONS IN HEAL SURVEY

Question asked	Options provided	Score assigned
During the past week, how many days did you eat breakfast?	• Never • 1-2 days • 3-4 days • 5-6 days • Every day	• 0 • 1 • 2 • 3 • 4
In the past week, how many times did you eat something from a fast food restaurant (like McDonald's, Burger King, Hardee's, Taco Bell, KFC, Chic-Fil-A, etc.)?	• Never • 1-2 times • 3-4 times • 5-6 times • 7 times • More than 7 times	• 5 • 4 • 3 • 2 • 1 • 0
During the past week, how often did you snack while watching TV?	• Never • Rarely • Sometimes • Usually • Always	• 4 • 3 • 2 • 1 • 0
During the past week, how many times did your family eat a meal together?	• Never • 1-2 times • 3-4 times • 5-6 times • 7 times • More than 7 times	• 0 • 1 • 2 • 3 • 4 • 5

APPENDIX P

PHYSICAL ACTIVITY BEHAVIOR QUESTIONS IN HEAL SURVEY

Question asked:	Options provided	Score assigned
How often is the following true? I get 30 minutes of physical activity after school.	• Never • Sometimes • Usually • Always	• 0 • 1 • 2 • 3
How often is the following true? I participate on a sports team.	• Never • Sometimes • Usually • Always	• 0 • 1 • 2 • 3
How often is the following true? I am very active during my PE class.	• Never • Sometimes • Usually • Always	• 0 • 1 • 2 • 3
How often is the following true? I walk up stairs rather than taking the elevator or escalator.	• Never • Sometimes • Usually • Always	• 0 • 1 • 2 • 3
How many hour do you spend each day watching TV or playing video or computer games?	• More than 6 hours • 4-6 hours • 2-4 hours • Less than 2 hours	• 0 • 1 • 2 • 3

APPENDIX Q

NUTRITION KNOWLEDGE ITEMS 7A-7E, PRETEST AND POSTTEST MEANS, STANDARD DEVIATIONS, AND CHI-SQUARE VALUES

7. For each of the following, which food do you think is healthier? If you don't know, choose Don't know. (Choose only one answer for each row).

a.	O	Pretzels	**OR**	O	Potato chips	**OR**	O	Don't know
b.	O	Whole milk (sweet milk)	**OR**	O	Skim milk	**OR**	O	Don't know
c.	O	Whole wheat bread	**OR**	O	White bread	**OR**	O	Don't know
d.	O	Fruit drink	**OR**	O	100% Fruit juice	**OR**	O	Don't know
e.	O	Frozen yogurt	**OR**	O	Ice cream	**OR**	O	Don't know

Pretest and Posttest Means, Standard Deviations and Chi-Square Values for Nutrition Knowledge Items 7a – 7e

	Pretest			Posttest			
	Intervention	Comparison	Obs	Intervention	Comparison	Obs	
Item	*M* (*SD*)	*M* (*SD*)	χ^2	*M* (*SD*)	*M* (*SD*)	χ^2	
7a	.71 (.46)	.74 (.44)	0.54	.86 (.35)	.81 (.40)	2.36	
7b	.59 (.49)	.64 (.48)	1.37	.80 (.40)	.68 (.47)	8.39	*
7c	.75 (.44)	.77 (.42)	0.34	.90 (.30)	.81 (.39)	8.51	*
7d	.78 (.42)	.83 (.39)	2.23	.92 (.27)	.94 (.23)	0.98	
7e	.80 (.40)	.82 (.39)	0.18	.93 (.25)	.89 (.32)	3.14	

*=$p < .01$

APPENDIX R

PHYSICAL ACTIVITY KNOWLEDGE ITEMS, PRETEST AND POSTTEST MEANS, STANDARD DEVIATIONS, AND CHI-SQUARE VALUES

16. A Healthy Heart Zone (HHZ) is the heart rate level that is best for you:
    - O when you are sleeping.
    - O while you are studying or in class.
    - O when you playing video games or watching television.
    - O when you are exercising to become healthy and fit.

18. How many minutes of moderate to vigorous activity should a fifth grade student get each day?
    - O 10 minutes
    - O 20 minutes
    - O 40 minutes
    - O 60 minutes

19. The Healthy Heart Zone (HHZ) for fifth grade students is:
    - O 60-80 beats per minute.
    - O 90-110 beats per minute.
    - O 140-170 beats per minute.
    - O 180-200 beats per minute.

Pretest and Posttest Means, Standard Deviations, and Chi-Square Values for Physical Activity Knowledge Items

	Pretest			Posttest			
	Intervention	Comparison	Obs	Intervention	Comparison	Obs	
Item	*M* (*SD*)	*M* (*SD*)	χ^2	*M* (*SD*)	*M* (*SD*)	χ^2	
16	0.85 (.36)	0.77 (.42)	5.18	0.90 (.31)	0.79 (.41)	10.53	*
18	0.42 (.49)	0.41 (.49)	0.29	0.81 (.39)	0.42 (.40)	87.16	*
19	0.21 (.41)	0.16 (.37)	1.64	0.68 (.47)	0.17 (.37)	142.50	*

*=p<.01

APPENDIX S

NUTRITION BEHAVIOR ITEMS, PRETEST AND POSTTEST MEANS, STANDARD DEVIATIONS, AND CHI-SQUARE VALUES

2. During the past week, how many days did you eat breakfast?
   - O Never
   - O 1-2 days
   - O 3-4 days
   - O 5-6 days
   - O Every day

3. In the past week, how many times did you eat something from a fast food restaurant (like McDonald's, Burger King, Hardee's, Taco Bell, KFC, Chic-Fil-A etc.)?
   - O Never
   - O 1-2 times
   - O 3-4 times
   - O 5-6 times
   - O 7 times
   - O More than 7 times

4. During the past week, how often did you snack while watching TV?
   - O Never
   - O Rarely
   - O Sometimes
   - O Usually
   - O Always

6. During the past week, how many times did your family eat a meal together?

   - O Never
   - O 1-2 times
   - O 3-4 times
   - O 5-6 times
   - O 7 times
   - O More than 7 times

Pretest and Posttest Means, Standard Deviations, and Chi-Square Values for Nutrition Behavior Items

	Pretest				Posttest		
	Intervention	Comparison	Obs		Intervention	Comparison	Obs
Item	*M* (*SD*)	*M* (*SD*)	χ^2		*M* (*SD*)	*M* (*SD*)	χ^2
2	2.95 (1.43)	2.15 (1.79)	52.80	*	3.24 (1.27)	3.24 (1.21)	3.96
3	4.61 (0.97)	4.67 (0.78)	7.17		4.74 (0.74)	4.75 (.68)	1.07
4	1.52 (1.11)	1.88 (1.03)	20.86	*	1.59 (1.10)	1.75 (1.00)	9.63
6	2.11 (1.69)	2.37 (1.88)	11.61		3.30 (1.65)	2.96 (1.76)	12.34

*p=<.000

APPENDIX T

PHYSCIAL ACTIVITY BEHVIOR ITEMS, PRETEST AND POSTTEST MEANS, STANDARD DEVIATIONS, AND CHI-SQUARE VALUES

11. How often are the following true?

		Never	Sometimes	Usually	Always
a.	I get 30 minutes of physical activity after school.	O	O	O	O
b.	I participate on a sports team.	O	O	O	O
c.	I am very active during my PE class.	O	O	O	O
d.	I would rather be outside playing than inside watching TV or playing video games.	O	O	O	O
e.	I enjoy doing activities that cause my heart to beat faster like playing sports, jumping rope, or swimming.	O	O	O	O
f.	I walk up stairs rather than taking the elevator or escalator.	O	O	O	O

Pretest and Posttest Means, Standard Deviations, and Chi-Square Values for Physical Activity Behavior Items 11a – 11f

	Pretest			Posttest		
	Intervention	Comparison	Obs χ^2	Intervention	Comparison	Obs χ^2
11a	2.09 (1.18)	2.02 (1.19)	4.46	2.40 (0.93)	2.32 (1.10)	6.86
11b	2.13 (1.13)	1.98 (1.22)	3.37	2.22 (1.05)	2.05 (1.16)	5.89
11c	2.43 (0.73)	2.48 (0.76)	4.73	2.44 (0.70)	2.47 (0.72)	3.73
11d	2.09 (0.87)	1.99 (0.92)	6.44	2.11 (0.85)	2.03 (0.87)	1.32
11e	2.53 (0.72)	2.45 (0.82)	4.23	2.46 (0.77)	2.53 (0.66)	4.82
11f	1.64 (0.97)	1.70 (0.98)	0.72	1.61 (0.93)	1.79 (0.90)	5.56

APPENDIX U

PHYSCIAL INACTIVITY BEHVIOR ITEM, PRETEST AND POSTTEST MEANS, STANDARD DEVIATIONS, AND CHI-SQUARE VALUES

12. How many hours do you spend each day watching TV or playing video or computer games?

    O More than 6 hours
    O 4-6 hours
    O 2-4 hours
    O Less than 2 hours

Pretest and Posttest Means and Standard Deviations for Physical Inactivity Item 12

Pretest			Posttest		
Intervention	Comparison	Obs χ^2	Intervention	Comparison	Obs χ^2
2.40 (0.80)	2.29 (.90)	4.65	2.39 (0.78)	2.26 (0.84)	4.12