School Based Exercise and Nutrition Intervention: Effects on Health Measures in Rural Children

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This thesis titled
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ABSTRACT

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From the 1970s to 2004, the incidence of overweight in American children ages 6-11 years old more than quadrupled. Research has shown that overweight children suffer from a vast number of psychological, social, and medical complications. Development of overweight status in childhood is influenced by a wide range of environmental factors such as dietary intake, advertising influences, television viewing, parental role modeling, and school influences. The American Dietetic Association recommends prevention of excess weight gain rather than treatment via a primary or secondary prevention method. A limited number of studies have focused on a family and school-based, multi-component prevention programs in children as young as 7 and 8 years of age. No published studies were found to have implemented this type of prevention in rural Appalachian children. Rural Appalachia is a region of the U.S. that is subject to higher incidence of poverty, obesity, and health disparities.

The goal of this study was to establish a new research design for prevention of overweight development among rural Appalachian children. The results of this study indicate that children with nutrition education choose healthier foods, indicated by the increase in the amount of milk consumption and dietary intake of magnesium. The results also indicated that 16 weeks is insufficient time to see body composition changes from exercise sessions or dietary intervention. Because a prevention study was
implemented, the implications of this research can not be determined until the children in this study are examined in the future.

Approved: _____________________________________________________________

Roger M. Gilders
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I am indebted to Dr. Gretchen McNally, my sister, for her patience analyzing data generated for my results. Gretchen’s support through countless email exchanges and phone discussions was critical for meeting my deadline.

I appreciate the continued professional support of Dr. Roger Gilders. Dr. Gilders initially decided to donate his time as an adviser to me. His support and guidance gave me the chance to partake in both exercise and nutrition research.

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CHAPTER 1: INTRODUCTION

The incidence of overweight children has reached epidemic levels in developed countries including Canada and the United Kingdom (Wang & Lobstein, 2006). However, the number of overweight children is increasing at a faster rate in the United States (Wang & Lobstein, 2006). Data collected from the 1970s to 2004 indicate that the number of overweight children in America ages 6 -11 has more than quadrupled from 4% to 19% (Center for Disease Control and Prevention [CDC], 2006a; Ogden, Carroll, et al. 2006; Wang & Lobstein, 2006). This increasing number of overweight children further exacerbates the world obesity epidemic, because research has indicated overweight children are likely to become obese adults (Cheung, Machin, Karlberg, & Khoo, 2004; Dietz, 1994; Himes & Dietz, 1994; Whitaker, Wright, Pepe, Seidel, & Dietz, 1997).

The growing number of overweight children also affects citizens and healthcare providers on a local level. In Ohio, 14% of teenagers are considered overweight and the state is ranked 13th in adult obesity status among states, with 25% of adults being obese (Trust for America’s Health [TFAH], 2006). Ohio’s Medicare and Medicaid costs associated with overweight and obesity were estimated to be 3.3 million dollars a year in data collected from 1998 to 2000 (Finkelstein, Fiebelkorn, & Wang, 2003).

In 2004, information obtained from the CDC was used to conclude that poor diet and inactivity are overtaking cigarette smoking as the leading cause of preventable death (Mokdad, Marks, Stroup, & Gerberding, 2004). Obesity is associated with the development of chronic medical conditions accounting for 300,000 deaths a year in the United States (U.S. Department of Health and Human Services [USDHHS], 2001).

Research has indicated that overweight children can develop chronic medical conditions
such as pulmonary diseases, cardiovascular risk factors, and type 2 diabetes (American Diabetes Association, 2000; Maffeis, Pietrobelli, Grezzani, Provera, & Kung, 2001; Wang & Dietz, 2002). These diseases are becoming more prevalent with increasing overweight status in children. For example, type 2 diabetes in children and adolescents from Cincinnati, OH increased from 0.7 per 100,000 to 7.2 per 100,000, a 10-fold increase over 12 years (Fagot-Campagna, et al., 2000). In other research studies, percentage of newly diagnosed type 2 diabetes in childhood increased from 4% up to 45% between 1990 and 2000 (Fagot-Campagna, et al., 2000).

It is hypothesized that children become overweight when energy intake exceeds energy expenditure. Although genetic factors influence susceptibility to weight gain, environmental factors are also thought to play a major role (Hill & Peters, 1998). Major environmental contributors include inactivity and excess consumption of high calorie foods and beverages (Berggren, Hulver, & Houmard, 2005; Berkey, Rockett, Field, Gillman, & Colditz, 2004; Booth & Winder, 2005; Bray & Champagne, 2005; Troiano, Briefel, Carroll, & Bialostosky, 2000). In addition, a growing number of families are buying convenience foods, dining out, and are influenced by marketing schemes (Borrud, Enns, & Mickle, 1996; Crockett & Sims, 1995; Isler, Popper, & Ward, 1987; Lin, Frazoa, & Guthrie, 1999). As calorie consumption increases in American children, sedentary behaviors are replacing physical activity (Christakis, Ebel, Rivara, & Zimmerman, 2004; Van Den Bulek & Eggermont, 2006) and schools are decreasing physical education, athletic programs, and recess time (Freedman, Dietz, Srinivasan, & Berenson, 1999; Parsad & Lewis, 2006).
Schools provide a pivotal role in development of overweight status in children because children are in a contained setting for a majority of the day. Schools have the opportunity to convey healthy eating habits via the curriculum, and meals or foods served during breakfast, lunch, snacks or in vending machines. Physical education classes and recess can provide minimum standards for the amount of time a child engages in vigorous activity. However, most schools give low priority to physical education and nutrition education because the curriculum is based on standardized competency tests (California Department of Education, 2002; TFAH, 2006). A majority of schools also seem to focus only on delivering minimum nutrition to students (TFAH, 2006).

Recommendations have been made to improve school nutrition and to enhance physical education in order to combat the growing number of overweight children (TFAH, 2006). In 2006, the American Dietetic Association (ADA) released an evidence-based position statement focused on interventions to help combat the number of overweight children. These included a combination of family and school-based programs such as physical activity, parent training, parent modeling, behavior counseling, and nutrition education. These interventions are based on primary, secondary, and tertiary levels of prevention. The ADA encourages development of multi-component primary and secondary prevention programs because these occur before children are overweight (ADA, 2006).

Statement of Problem

Overweight status in children must be approached as a preventable and treatable problem with accessible opportunities to improve health and save lives (USDHHS, 2001). The U.S. Department of Health and Human Services (USDHHS, 2001)
recommends a community-oriented multifaceted approach focusing on the improvement of health and a reduced prevalence of overweight children. Lack of objective local community research endeavors, specifically in elementary schools, has been noted in various health reports (ADA, 2006; TFAH, 2006). Attempts to control the increasing number of overweight children by policymakers and legislation have yielded disappointing results (TFAH, 2006). Therefore, new research designs need to be implemented, focusing on early interventions among children (ADA, 2006). Dietetic professionals are favorably positioned to engage in multi-component interventions to help prevent the rising prevalence of overweight children.

Purpose of Study

The purpose of this study was to implement an exercise and nutrition program as an intervention strategy for the prevention of overweight status in elementary schools with second grade children, ages 7 to 8 years. This study will support and augment existing programs currently being implemented in selected schools and may provide objective data that could have implications for further intervention and practice.

Research Questions

Focusing on second grade children, ages 7-8, who are enrolled in a rural southeastern Ohio school district, the following research questions were posed:

1. Will nutrition education of the child result in healthier dietary behaviors based on intake of target nutrients and pyramid food groups?
2. Will a 16-week nutrition education and exercise intervention change anthropometric data (BMI and percent body fat)?
Assessing Weight Status

Childhood obesity, defined as excessive body fat in relation to lean body mass, (CDC, 2007) has significantly increased around the world (Wang & Lobstein, 2006). In the United States, the CDC avoids using obesity to classify children, but instead categorizes those with weight >95th percentile for age and gender (BMI-for-age) as overweight (see Appendix A). Obesity however, is still often used to describe children in scientific literature and is generally defined as a BMI >95th percentile of gender and age peers. The definitions of overweight and obesity in children sometimes differ between studies, making comparisons of cross-sectional prevalence data difficult; however, Table 1 provides current BMI-for-age classifications using CDC guidelines. CDC guidelines will be used throughout this discussion.

Table 1

<table>
<thead>
<tr>
<th>Classification</th>
<th>Percentile based on age and gender</th>
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<tr>
<td>Underweight</td>
<td>Below the 5th percentile</td>
</tr>
<tr>
<td>Healthy weight</td>
<td>5th to 84th percentile</td>
</tr>
<tr>
<td>At risk of overweight</td>
<td>85th to 94th percentile</td>
</tr>
<tr>
<td>Overweight</td>
<td>Equal to or above the 95th percentile</td>
</tr>
</tbody>
</table>

Body composition is used to determine fat status in children. Using a two-compartment model, body composition is expressed as the relative percentage of fat mass and fat-free mass. A variety of direct, indirect, and doubly indirect assessment techniques are used to determine body fatness. Direct methods are derived from analysis of cadavers, and are the foundation upon which indirect and doubly indirect methods are developed. Indirect body composition methods include: hydrodensiometry (underwater weighing), dual-energy X-ray absorptiometry (DEXA), magnetic resonance imaging (MRI), and plethysmography (air displacement). Doubly indirect methods are derived from indirect methods which include: skin fold analysis, bioelectrical impedance (BIA), and near-infrared. Doubly indirect methods take into account subcutaneous tissue only and are at a higher risk for inaccuracy compared to indirect methods. In most cases, inaccuracy from doubly indirect methods results from clinician error due to inadequate training (Jackson, 1984; Nicholson, et al., 2001).

In this study, skin-fold measurements were used to assess body composition due to feasibility, low cost, and accuracy. The underlying assumption when performing skin fold equations is that approximately one third of total fat is located subcutaneously when compared to total body fat (Heyward & Stolarczyk, 1996). The sum of all skin folds was entered into a gender, age, and ethnic specific equation to predict percent body fat (Heyward & Stolarczyk, 1996).

Waist circumference was used as a determinant of adipose distribution in the trunk region (Goran, Gower, Treuth, & Nagy, 1998). This type of fat can be accurately assessed by computed tomography (CT), MRI, or waist circumference measurements.
Due to feasibility, waist circumference is a common, yet accurate, way of measuring abdominal fatness in children (Taylor, Jones, Williams, & Goulding, 2000). In children and adolescents, values at the 90th percentile or higher for age and gender are used to identify abdominal obesity (Cook, Weitzman, Guinger, Nguyen, & Dietz, 2003).

Weight Trends

The population of overweight children has been rising by more than one percentage point each year in several countries, including the U.S. and Canada (Wang & Lobstein, 2006). This trend appears in almost all industrialized countries for which adequate data is available (Wang & Lobstein, 2006). In the United Kingdom, prevalence of childhood obesity nearly tripled from 1984 to 1994 in 4 to 11 years olds (Chinn & Rona, 2001). United Kingdom data collected in 1999 indicated 25% of children 11 to 12 years old were overweight and at risk for overweight, with black girls being the most affected at 38% (Wardle, Brodersen, Cole, Jarvis, & Boniface, 2006). The incidence of overweight Canadian children age 7 to 13 increased fivefold over 1981 to 1996, from 2% to 10% in boys and from 2% to 9% in girls (Tremblay, Katzmarzyk, & Willms, 2002). Over the same time frame and in the same age group, at-risk status for overweight incidence tripled in boys and doubled in girls, from 11% to 33% and 13% to 27%, respectively (Tremblay et al., 2002). Canada’s at-risk status for overweight and overweight prevalence in young children increased 27% between 1997 and 2002 (Canning, Courage, & Frizzell, 2004; Willows, Johnson, & Ball, 2006). However, caution must be taken when comparing levels of overweight children in research in which different anthropometric standards and methods are used.
United States Weight Trends

*Healthy People 2010* was established in 2000 to increase the quality of life and to eliminate health disparities in the United States. Reducing overweight children to below 11% is one of the objectives (Office of Disease Prevention and Health Promotion, 2006). Unfortunately, the number of overweight children has steadily increased rather than decreased (CDCa, 2006; CDCb, 2006; Ogden, Carroll et al., 2006; Ogden, Flegal, Carroll, & Johnson, 2002; Wang & Lobstein, 2006).

The percent of overweight children and adolescents remained relatively stable from the 1960s to the early 1980s, with only a 2.5% increase for children 6 to 11 years and no change for those ages 12 to 19 (CDCa, 2006; CDCb, 2006; Ogden, Carroll, et al., 2006; Ogden, Flegal, et al., 2002). From the 1980s through the 1990s, incidence of overweight tripled in adolescents and more than doubled in children 6 to 11 years old (CDCa, 2006; CDCb, 2006; Ogden, Carroll, et al., 2006; Ogden, Flegal, et al., 2002; Wang & Lobstein, 2006). Overweight prevalence rose twice as fast among minority children age 4 to 12 years compared to non-minority counterparts of the same age during the years 1986 to 1998 (Strauss & Pollack, 2001). The National Health and Nutrition Examination Survey (NHANES) reported that the prevalence of overweight children ages 6 to 11 years old increased from 4% in 1971-74 to 19% in 2003-04 (CDCa, 2006; Ogden, Carroll, et al., 2006; Wang & Lobstein, 2006). During 2003-04, 37% of 6 to 11 year old children were considered to be at risk for overweight, with a BMI at the 85th percentile or higher of gender- and age- matched peers (CDCa, 2006; Ogden, Carroll, et al., 2006; Wang & Lobstein, 2006).
Overweight adolescents are a concern since BMI values at ages 11 and 16 were found to predict adult obesity, diabetes, and hypertension in middle age (Cheung et al., 2004). NHANES figures which indicate the prevalence of overweight adolescents 13 to 19 years increased from 11% in 1988-94 to 17% in 2003-04 (CDCa, 2006; Ogden, Carroll, et al., 2006). The 2003-04 findings suggest the likelihood of another generation of adults at risk for weight-related health conditions and increased morbidity and mortality.

Waist-Circumference Trends

In addition to an increasing BMI, waist circumference is expanding in children and adolescents (Li, Ford, Mokdad, & Cook, 2006). Between NHANES III (1988-1994) and NHANES 1999-2004, mean waist circumference increased by 3.7 cm in both boys and girls 2 through 19 years of age (Li et al., 2006). Among 6 to 11 year olds, waist circumference increased on average by 2.6 cm in boys and 3.1 cm in girls (Li et al., 2006). Since NHANES III (1988-1994), prevalence of abdominal obesity measured by waist circumference has increased in 2 to 18 year olds by 65.4% for boys and 69.4% for girls (Li et al., 2006).

Fat stored in the abdominal region has been shown to increase the risk for cardiovascular disease and diabetes (Cook et al., 2003; Folsom, et al., 1993; Rodrigues, et. al., 2006). For Americans, these two weight-related diseases represent the first and sixth leading cause of death, respectively (Hoyert, Heron, Murphy, & Kung, 2006). In children, excessive waist circumference has been associated with increasing cardiovascular risk factors such as adverse blood-lipid profile, and hypertension (Cook et al., 2003; Maffeis et al., 2001).
Weight and Economic Status

Information reported in the early 1990s suggested that food shortages associated with poverty are predictive of increased body fat in children (Dietz, 1995; Mei et al., 1998). These early findings shaped current beliefs that continue to influence perception among many citizens and health professionals. Although, more recent research indicates that children from impoverished families are not more likely to be overweight (Kaiser, Melgar-Quiñonex, Lamp, Johns, & Harwood, 2002; Matheson, Varady J., Varady A., & Killen, 2002; Wang & Lobstein, 2006), these economically disadvantaged children are at risk for nutrient deficiencies (Bhattacharya, Currie, & Haider, 2004) and obesity later in life (Okasha et al., 2003). Data indicate that children from food insecure households are 20% less likely to be overweight then children from food secure homes (Rose & Bodor, 2006). Conversely, a recent study analyzing NHANES data from 1999 through 2002 associated food insecurity with being at risk for overweight (but not overweight) in children aged 3 to 5 years (Casey, et al., 2006). Based on inconsistent findings, it is apparent that more research needs to be conducted on different variables before firm conclusions are drawn about overweight development and economic status alone.

Two variables of notable interest in the development of overweight children are the combination of poverty and geographical area of residence in the United States. Over the past few years, data have been published with regard to high rates of overweight development in young children living in impoverished Appalachian regions of the U.S. A 2002 study in Appalachia assessed overweight incidence among 5,887 students aged 10 to 12 years in 27 West Virginia counties (Muratova et al., 2002). Results from this study revealed that 43% of these students to be at risk for overweight and 25% to be
overweight, signifying that over half of students attending school in this geographical area are an undesirable weight. Another West Virginia study determined that 45% of 1,413 fifth graders (approximately 9 to 10 years old) were at risk for overweight or were already overweight (Demerath et al., 2003). A study with 437 children from impoverished areas of West Virginia indicated that 31% of 4 to 6 year olds were at risk or were already overweight (Cottrell et al., 2005).

Weight status based on economic level appears to be consistent in other countries, with low prevalence of overweight and obesity in low-income countries (Asia and sub-Saharan Africa) or in countries suffering poor economic development, such as the Russian Federation and Eastern European countries (Wang & Lobstein, 2006). In middle-income countries, citizens of higher economic status are more likely to be at risk of becoming overweight when compared to their impoverished counterparts (Wang & Lobstein, 2006). A recent exception was found in London, where school children from low socioeconomic backgrounds were more likely to be overweight when compared to their higher socioeconomic counterparts (Wardle et. al, 2006). Countries rebounding from economic depression have a sharp rise in obesity (Wang & Lobstein, 2006).

Poverty early in life positively correlates with obesity later in life (Okasha et al., 2003). One hypothesis suggests that impoverished children may be subjected to prolonged periods of malnutrition, causing growth stunting (Branca & Ferrari, 2002; Martins, et al., 2004). Consequences of growth stunting include metabolic alterations such as reduced basal metabolism leading to obesity (Branca & Ferrari, 2002; Martins, et. al., 2004).
Appalachia

The Appalachian region of the U.S. is defined geographically as a federally-designated area that includes 410 counties in parts of 13 states with entire inclusion of West Virginia (see Appendix B). The Appalachian Regional Commission (ARC) has divided Appalachia into three distinct subregions: Northern, Southern, and Central (see Appendix C). Southern Ohio is considered part of Northern Appalachia. This area contains over 1.4 million Appalachian residents in 29 counties, which is nearly one-third of Ohio’s 88 counties (The Foundation for Appalachia Ohio, 2006). The ARC classifies Appalachian counties into one of five economic categories: distressed, at risk for distress, transitional, competitive, or attainment (see Appendix D). Counties are categorized by national figures for three-year average unemployment rate, per-capita market income, and poverty rate (ARC, 2007). Table 2 displays how counties are classified.
### Table 2

**ARC County Classification System Based on Economic Status**

<table>
<thead>
<tr>
<th>Category</th>
<th>Three-Year Average Unemployment</th>
<th>Per-Capita Market Income</th>
<th>Poverty Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distressed</td>
<td>150% or more of U.S. Average</td>
<td>67% or less of U.S. Average</td>
<td>150% or more of U.S. Average</td>
</tr>
<tr>
<td>At-Risk</td>
<td>125% or more of U.S. Average</td>
<td>67% or less of U.S. Average</td>
<td>125% or more of U.S. Average</td>
</tr>
<tr>
<td>Transitional</td>
<td>All counties worse than the national average but do not meet the criteria for the distressed or at-risk levels.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competitive</td>
<td>100% or less of U.S. Average</td>
<td>80% or more of U.S. Average</td>
<td>100% or less of U.S. Average</td>
</tr>
<tr>
<td>Attainment</td>
<td>100% or less of U.S. Average</td>
<td>100% or more of U.S. Average</td>
<td>100% or less of U.S. Average</td>
</tr>
</tbody>
</table>


Most of Appalachia is economically disadvantaged with 77 counties currently classified as distressed and 81 counties at risk for distress (see Appendix D). Families residing in distressed regions and those regions at risk for distress have a high risk of unemployment and poverty (ARC, 2007). In Appalachia Ohio, currently four counties are considered economically distressed and six are at risk for distress (see Appendix D).
This study took place in Athens, one of the four economically distressed Ohio counties which borders the other three distressed counties: Meigs, Ross, and Vinton.

In addition to widespread poverty, Appalachian Ohioans residing in distressed counties are ranked among the highest at risk for mortality from cardiovascular disease (see Appendix E). The cause for this high mortality is thought to result from shortages of essential health professionals and hospitals, increased obesity incidence, and limited access to grocery stores and activity resources (ARC, 2007). Poverty in the area also makes it difficult for many residents to receive adequate medical care, and afford transportation necessary to seek medical care (ARC, 2007). Poverty may also serve as a barrier for access to safe and complete food sources. A study conducted in Athens county by Holben, McClincy, Holcomb, Dean, and Walker (2004) found that nearly half of households enrolled in Head Start were food insecure. This may account for children in some Appalachian regions being ranked lowest among states for rates of fruit and vegetable consumption (CDC, 2002).

Rural Living

Just under half (42%) of Appalachia is considered rural, compared to only 20% of the national population (ARC, 2007). There is no single definition of rural. Rural definitions are used to identify rural people, places, or health care providers, and definitions are typically based on geographic units combined with population characteristics (Coburn et al., 2007). ZIP code areas are commonly used to identify rural areas because ZIP code borders have no defined relationship to city and county boundaries, and allow for a finer level of geographic precision than do counties (Coburn et al., 2007). The schools in this study were identified rural using ZIP code definitions
along with both the Census Bureau’s and The Office of Management and Budget’s (OMB) definitions.

To determine rurality, the Census Bureau first defines urbanized areas (area with at least 50,000 people and other places with at least 2,500 people) and then further classifies all territory, population, and housing units within these areas as an urbanized area (UA) or an urban cluster (UC; Center for Family and Demographic Research, 2004). Rural areas consist of all areas outside of the UAs and UCs with fewer than 2,500 residents (Center for Family and Demographic Research, 2004). The OMB defines rural and urban based on metro and nonmetro county classifications (USDA Economic and Research Service, 2007a). Metro counties are central counties with one or more urbanized areas or they are considered outlying counties economically tied to the core counties (USDA Economic and Research Service, 2007a). Metro counties include a core area in which adjacent communities have a high degree of economic and social integration with that core (USDA Economic and Research Service, 2007a). Nonmetro counties are outside the boundaries of metro areas and are divided into noncore counties and micropolitan areas (USDA Economic and Research Service, 2007a).

Based on the OMB’s definition, nearly half of Ohio’s counties (48 out of the 88 counties) are considered nonmetro (USDA Economic and Research Service, 2007a). Based on 2001 data, a third (33.5%) of Ohio’s public school students attend a school in a small town or rural area (Center for Family and Demographic Research, 2004). The schools involved in this study were located in the Federal Hocking School District deemed part of rural Appalachia. Thus, the children and their parents involved in this
study were living in an area with characteristics associated with a rural Appalachian setting.

Policy makers and researchers distinguish a county as rural, because higher poverty and unemployment rates along with lower education levels are more prevalent in these areas compared to metro areas (United States Department of Agriculture, 2007b). In addition, these areas are located in areas with shortages of health and dental care professionals (United States Department of Agriculture, 2007b). Furthermore, rates of overweight and obesity have been found to be higher in rural areas, particularly in school-children (Cherry, Huggins, & Gilmore 2007; Patterson, Moore, Probst, & Shinogle, 2004; Singh, Kogan, & Van Dyck, 2008). All of these factors contribute to rural citizens having higher rates of diabetes complications, cardiovascular risk factors and increased mortality from cardiovascular diseases compared to those living in metropolitan areas (Aiello & Fahs, 2001; Appel, Harrell, & Deng, 2002; Barnett & Halverson, 2001; Evans & Kantrowitz, 2001; Kettle, Roebotan, & West, 2005; Neil, 2002; Tessaro, Smith, & Rye, 2005).

Psychological and Social Consequences of Being an Overweight Child

Excess weight alters a child’s physical appearance which may result in both psychological and social consequences such as lowered self-esteem, increased sadness and loneliness, social isolation, lowered self-confidence, body dissatisfaction, and discrimination (Dietz, 1998; Hughes, Farewell, Harris, & Reilly, 2007; Strauss, 2000, Tulkki et al., 2006; Wabitsch, 2000). Overweight school children are a target for peer victimization, which can exacerbate negative social and psychological manifestations of excess weight (Janseen, Craig, Boyce, & Pickett, 2004; Pearce, Boegers, & Prinstein,
These psychological manifestations may lead to diminished academic performance in school (Datar, Sturm, & Magnabosco, 2004; Davison & Birch, 2001; Xie, et al., 2006). Decreased self-esteem in overweight children may initiate risky behaviors such as drinking alcohol or smoking cigarettes (Abernathy & Massad, 1995; Jackson, 1997). In addition, it has also been shown in multiple studies that adolescents use smoking to aid in weight control efforts (Fulkerson & French, 2003; Lowry, Galuska, Fulton, Wechsler, & Kann, 2002; Paxton, Valois, & Drane, 2004; Ryan, Gibney, & Flynn, 1998; Tomeo, Field, Berkey, Colditz, & Frazier, 1999). These psychological manifestations may further increase medical complications and costs. For example, cigarette smoking may increase risks and costs associated with cardiovascular diseases, cancer, and pulmonary diseases (American Heart Association, 2008).

**Medical Consequences of Being Overweight**

Excess weight persists from childhood to adolescence into adulthood and is associated with serious medical complications and conditions (Cheung et al., 2004; Whitaker et al., 1997; Wang & Dietz, 2002). Early physical consequences of being overweight include orthopedic complications, impaired mobility (Taylor, et al., 2006), and metabolic disturbances (Martins, et al., 2004). Pulmonary complications that may arise include asthma, disrupted sleep patterns (Wang & Dietz, 2002), and exercise intolerance (Reybrouck, Mertens, Schepers, Vinckx, & Gewillig, 1997). Overweight children develop cardiovascular risk factors such as hypertension, dyslipidemia, chronic inflammation, endothelial dysfunction, and hyperinsulinemia (Freedman et al., 1999; Ribeiro et al., 2006; Rodrigues et al., 2006).
Diabetes mellitus is the cause of over 74,000 deaths annually (Hoyert et al., 2006). Type 2 diabetes, once unrecognized in children, now accounts for half of all new diagnoses in certain population groups under age 20 (Moore, Harwell, McDowall, Helgerson, & Gohdes, 2003). In people with type 2 diabetes, the pancreas still produces insulin which is used in carbohydrate metabolism; however, the pancreas cannot make enough insulin or the body cannot utilize the insulin made (National Institute of Diabetes & Digestive & Kidney Diseases [NIDDK], 2007). Although type 2 diabetes commonly occurs in adults, an increasing number of overweight children and adolescents are also developing the disease. In 1990, type 2 diabetes accounted for less than 4% of all new-onset cases in children and adolescents in the U.S. compared to the beginning of the twenty-first century when it accounted for almost 45% in some population estimates (Fagot-Campagna et al., 2000). Table 3 summarizes frequency of type 2 diabetes in children.
Table 3

*Estimates of Type 2 Diabetes Prevalence in North American Children*

<table>
<thead>
<tr>
<th>Study Types</th>
<th>Years</th>
<th>Race/Ethnicity</th>
<th>Age</th>
<th>Estimates</th>
</tr>
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<tr>
<td>Arizona</td>
<td>1992-1996</td>
<td>Pima Indians</td>
<td>10-14</td>
<td>22.3 per 1,000</td>
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<tr>
<td></td>
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<td></td>
<td>15-19</td>
<td>50.9</td>
</tr>
<tr>
<td>Manitoba</td>
<td>1996-1997</td>
<td>Cree &amp; Ojibway</td>
<td>10-19</td>
<td>36.0 in girls</td>
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<td>NHANES III (U.S.)</td>
<td>1988-1994</td>
<td>Whites, AA, MA</td>
<td>12-19</td>
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<tr>
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<tr>
<td>Indian Health</td>
<td>1996</td>
<td>American Indians</td>
<td>0-14</td>
<td>1.3* per 1,000</td>
</tr>
<tr>
<td>Services (U.S.)</td>
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<td></td>
<td>15-19</td>
<td>4.5*</td>
</tr>
<tr>
<td>Manitoba</td>
<td>1998</td>
<td>Cree &amp; Ojibway</td>
<td>5-14</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>15-19</td>
<td>2.3</td>
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<tr>
<td><strong>Clinic-Based</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
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<td>1994</td>
<td>Whites, AA</td>
<td>10-19</td>
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<tr>
<td><strong>Case Series</strong></td>
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<td>1997</td>
<td>AA</td>
<td>0-19</td>
<td>46†</td>
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<tr>
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<td>1993-1994</td>
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<tr>
<td></td>
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<td>Asian</td>
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*(table continues)*
Table 3 (continued)

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<th>Ethnicity</th>
<th>Age</th>
<th>Number</th>
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<tr>
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<td>1990-1994</td>
<td>Hispanics, 0-17</td>
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</tbody>
</table>


Reports on type 2 diabetes have begun to show similar patterns as obesity worldwide (Fagot-Campagna, et al., 2000; Pinhas-Hamiel & Zeitler, 2005). Excessive body fat appears to be a contributing factor for diabetes (Fagot-Campagna et al., 2000). Reports indicate up to 85% of children affected with type 2 diabetes have BMIs greater than the 85th percentile upon diagnosis (American Diabetes Association, 2000; Fagot-Campagna, et al., 2000). Despite increasing prevalence of the disease in children and adolescents, its magnitude may be underestimated, as many cases remain undiagnosed and up to 25% are misclassified as Type 1 diabetes (American Diabetes Association, 2000; Fagot-Campagna, et al., 2000).

Chronic Medical Complications and Consequences from Obesity

Fifty percent of overweight children become overweight adults, resulting in increased morbidity and mortality secondary to obesity-related diseases in adulthood (Dietz, 1994; Himes & Dietz, 1994; Whitaker et al., 1997). One report indicated that even being in the upper half of the normal weight range (up to the 84th percentile) during
childhood was a good predictor of becoming overweight or hypertensive as a young adult (Field, Cook, & Gillman, 2005). Even moderate weight excess of 10 to 20 pounds increases the risk of death among adults 30 to 64 years old (Calle, Thun, Petrelli, Heath, & Rodriguez, 1999). Adults who develop type 2 diabetes as a consequence of being overweight childhood have higher rates of early mortality compared to those who develop diabetes in late adulthood (Nieto, Szklo, & Cornstock, 1992). A 57 year follow-up study revealed death via ischemic heart disease doubles in adults who were considered overweight during childhood (Gunnell, Frankel, Nanchahal, Peters, & Smith, 1998).

Medical complications associated with obesity will negatively affect the economy. An economic consequence of obesity is the dramatic increase in related healthcare costs. Direct health care costs refer to preventive, diagnostic, and treatment services and indirect costs are associated with wages lost from illness or disability (USDHHS, 2001). Over the last two decades, health care costs more than tripled for overweight youth aged 6 to 17, costing United States citizens an additional $92 million (Wang & Dietz, 2002). In 1995, the total healthcare costs attributed to overweight citizens was approximately $99 billion (Wolf & Colditz, 1998). In 2000, the total cost attributed to overweight conditions was an estimated $117 billion (UDHHS, 2001). In 2002, medical expenditures associated with diabetes were estimated at $132 billion (Hogan, Dall, & Nikolov, 2003). The increased incidence of diabetes and corresponding complications in children will deepen the societal burden of the disease (American Diabetes Association, 2000).
Environmental Mechanisms for Overweight Development

The obesity predisposing genotype is present in approximately 10% of the population; however, human genetic make-up has not changed dramatically in the past three decades (Herbert, et al., 2006). Because being overweight cannot entirely be attributed to changes in genetic inheritance, the increase must be due, in large part, to changes in environmental factors. Two major environmental contributors to overweight children are inactivity and imbalanced calorie intake stemming from poor dietary habits (Berggren et al., 2005; Booth & Winder, 2005; Bray & Champagne, 2005).

Dietary Evidence

Dietary contributors include excess consumption of high calorie, sugar-filled foods and beverages (Berggren et al., 2005; Berkey, Rockett, Field, Gillman, & Colditz, 2004; Booth & Winder, 2005; Bray & Champagne, 2005; Troiano et al., 2000). In addition, a growing number of families are buying convenience foods, are dining out, and are influenced by marketing schemes (Borrud et al., 1996; Crockett & Sims, 1995; Isler et al., 1987; Lin et al., 1999). Nutrient intake trends over three recent collections of NHANES data (1971-1974; 1976-1980; 1988-1994) determined the dietary etiology of increasing overweight status in children (Troiano et al., 2000). Nutrient intake trends over those past thirty years indicates that mean energy intake has remained relatively unchanged (except for an increase among adolescent females) while fat consumption has decreased as percent of total calories. Nevertheless, 33.5% of calories ingested are from fat, and that intake amount remains above recommended levels for health (Troiano et al., 2000). With no clear evidence indicating an increase in energy, other dietary trends must be contributing to weight gain.
Over the same time period of NHANES, the consumption of soft drinks, fruit punch, and fruit juice increased to be the top contributors of energy intake (Borrud et al., 1996; Bowman, 2002; Troiano et al., 2000). Results of a cross-sectional study showed that total energy intake was about 10% greater among school-age children who consumed soft drinks compared to those who did not consume soft drinks (Harnack, Stang, & Story, 1999). Despite findings of higher caloric intake among youngsters consuming soft drinks, research has not found a significant difference in mean BMI associated with sweetened beverage consumption alone; therefore, a combination of variables may be responsible for increasing weight gain trends (O’Connor, Yang, & Nicklas, 2006; Rajeshwari, Yang, Nicklas, & Berenson, 2005; Skinner & Carruth, 2001; Storey, Forshee, Weaver, & Sansalone, 2003).

Sugar-laden beverages have replaced milk consumption (Borrud et al., 1996; Harnack et al., 1999; Rajeshwari et al., 2005), and substituting soda/juice for milk has shown to cause weight gain in children (Berkey, Rockett, Field et al., 2004). Between 1977 and 1994, milk consumption decreased by 24% among boys and 32% among girls 6 to 11 years old (Borrud et al., 1996). During the same time period, teenage girls’ soft drink consumption increased by 41% and teenage boy’s intake nearly tripled, further reducing milk intake in adolescents (Borrud et al., 1996; Bowman, 2002; Troiano, 2000). Although milk contains calories and sometimes fat, related weight gain has not been shown to be a significant outcome as the child ages (Berkey, Rockett, Field et al., 2004). Milk when compared to other beverages may promote greater satiety; therefore, fewer total calories are ingested throughout the day (Berkey, Rockett, Field et al., 2004). Fewer
total calories ingested daily will promote weight maintenance or possible weight loss in overweight individuals.

More Americans, particularly women and children, are eating foods away from home, which also can contribute to poor dietary habits (Borrud et al., 1996). Between 1977 and 1994, the number of people eating away from home at least once a day increased by 14% in children 5 and under, 19% in boys 6 to 11 years, and 10% in girls 6 to 11 years (Borrud et al., 1996). During the same time period, the proportion of fast food meals increased by 166% for males 6 to 19 years old (Borrud et al., 1996). Also, during the 1990s, 46% of family food expenditures were for foods and beverages eaten outside the home (Crockett & Sims, 1995) and 30.3% of 4 to 19 year olds ate fast food on any given day (Bowman, Gortmaker, Ebbeling, Pereira, & Ludwig, 2004). The increasing frequency of eating at fast food restaurants is positively associated with intake of total energy, percent of energy from fat, sweetened beverage consumption, and inversely associated with daily servings of fruit, vegetables, and milk (Bowman et al., 2004; French, Story, Neumark-Sztainer, Fulkerson, & Hannan, 2001). Only 40% of Americans consume five or more servings of fruits and vegetables a day with less than one-third the recommended amount of dark green vegetables, orange vegetables, and legumes (Guenther, Dodd, Reedy, & Krebs-Smith, 2006). Thus, an increase in eating at fast food restaurants increases the risk for being overweight due to a limited intake of fruits and vegetables and an increase in overall calories and fat.

Advertising Effects on Dietary Intake

Advertising on television (TV) is hypothesized to be one influence on children’s food selection (Gamble & Cotunga, 1999; Story, Neumark-Sztainer, & French, 2002).
Children on average view more than three hours of commercials a week (Gamble & Cotunga, 1999). Advertisements targeting children occur 11% of the time during children’s television programming (Kotz & Story, 1994). Over half of all commercials on TV emphasize high calorie foods with relatively fewer references to fruits or vegetables (Gamble & Cotunga, 1999). In one study, the effects of commercial viewing revealed that exposure to a 30-second commercial increases the likelihood that a 3- to 5-year-old will later select the advertised food over other options (Borzekowski & Robinson, 2001). Children residing in unsafe neighborhoods may be exposed to a greater number of commercials, because children in such neighborhoods view at least two additional hours of TV compared to children from safe neighborhoods (Burdette & Whitaker, 2005).

Food advertising geared toward children is not limited to TV. Popular cartoon characters are seen on snack foods at the grocery store, on billboards, the internet, and in schools. In 1999, US advertising expenditures for food products totaled $7.3 billion dollars, with most money spent on convenience or processed foods at 1.3 billion dollars and snack foods closely behind at 1.2 billion dollars (Harris, Kaufman, Martinez, & Price, 2002). Companies spend money on advertising because of the effect children may exert on the purchase behavior of families (Molnar, 2005; Isler et al., 1987). Nearly half of food products requested by children from their mother are snacks. Children requested cereal 7% of the time (two-thirds of these requests were for sweetened cereals) and fruits or vegetables only 3% of the time (Isler et al., 1987). Fruits, vegetables, and cereal are low calorie and high fiber foods which may contribute to weight maintenance. This
research indicates that children are choosing higher calorie foods that if consumed in excess, will lead to weight gain.

Sedentary Behaviors

Children and adolescents have become increasingly occupied with information and communication technology (ICT) such as TV, computers, and video games (Christakis et al., 2004; Van Den Bulck & Eggermont, 2006). ICT has been found to be associated with an increase in overweight prevalence in children and adolescents (Deheeger, Rolland-Cachera, & Fontvieille, 1997; Gable, Chang, & Krull, 2007; Kautiainen, Koivusilta, Lintonen, Virtanen, & Rimpela, 2005; Robinson, 1999; Rose & Bodor, 2006; Stettler, Signer, & Suter, 2004; Storey et al., 2003). Children who watch more television may remain persistently overweight from kindergarten through the end of third grade. Excessive TV viewing during elementary school negatively affects a child’s BMI for the next 10 to 30 years (Gable et al., 2007; Viner & Cole, 2005). Conversely, educating children on benefits of limiting ICT has been shown to decrease ICT usage that, in turn, can decrease BMI (Robinson, 1999).

Weight gain resulting from ICT usage occurs via limited calorie expenditure from reduced physical activity, increased exposure to advertising, and increased caloric intake through snacks, meals, or sweetened beverages (Francis, Lee, & Birch, 2003; Stettler et al., 2004; Stroebele & de Castro, 2004; Van Den Bulck & Van Mierlo, 2004). Increase usage of ICT results in other unhealthy habits such as meal skipping, rapid eating, fewer family meals, and eating in front of the TV (Christakis et al., 2004; Gable et al., 2007; Van Den Bulck & Eggermont, 2006). The amount of time viewing TV also positively
correlates to fast food consumption in children 2 to 6 years old and adolescents 11 to 18 years (Taveras et al., 2006).

Watching more than two hours of TV per day is a predictor of overweight status in children as early as in kindergarten (Rose & Bodor, 2006). On average, one hour of TV viewing has been found to increase energy intake via snacking by 156 calories, which if done daily, can result in over one pound weight gain per month (Van den Bulck & Van Mierlo, 2004). Additional weight gain may occur if TV viewing is replacing regular physical activity. Because of weight gain and other negative health effects of TV viewing on children, the American Academy of Pediatrics has recommended limiting TV viewing to no more than 2 hours per day for children over 2 years of age (American Academy of Pediatrics, Committee on Education, 2001). However, it appears that the majority of U.S. children are continually exposed to television with 26% of children younger than age 11 having a TV in their bedroom and 30% eating breakfast or dinner in front of the TV (Christakis et al., 2004).

Role of Families

To counteract these unhealthy behaviors, family members need to serve as role models for healthy eating, regular exercise, and limit the time viewing non-essential ICTs. Children often model parents which may explain why children from overweight families have higher BMIs compared to non-overnight families (Francis et al., 2003). Children from overweight families consume more snacks overall, more high fat snacks, more snacks while watching television, and view more television than in non-overnight families (Francis et al., 2003).
Parents need to model meal structure to prevent meal skipping in youngsters (Siega-Riz, Popkin, & Carson, 1998). A 1998 study found that 12% of U.S. children skip breakfast daily (Siega-Riz et al., 1998). Skipping breakfast is associated with overweight status in children; in contrast, the habit of daily breakfast consumption leads to overweight children losing weight (Berkey, Rockett, Gillman, 2003; Nicklas, Reger, Myers, & O’Neil, 2000; Siega-Riz et al., 1998).

Eating meals together is an excellent way to ensure the overall quality of children’s diets (Gillman, et al., 2000). Eating together in today’s society is rare, with less than one half of 9-year-olds eating dinner with their families (Gillman et al., 2000), and 35% to 45% of a family’s budget divided towards high fat fast foods eaten outside the home (Crockett & Sims, 1995; Lin et al., 1999). Children who eat dinner with their families are more likely to have higher intakes of fruits and vegetables, fewer fried foods outside the home, less soda, and are less likely to be overweight (Gable et al., 2007; Gillman et al., 2000). This healthy eating pattern may account for why children eating dinner with their families have higher intakes of fiber, calcium, folate, iron, vitamin C, and vitamin E that are typically low for children (Gillman et al., 2000).

Role of Schools in Dietary Intake

A potentially negative influence on childhood weight is the use of advertising in public schools where in-school marketing to students has the potential to reach a large target audience in a contained setting. The country’s current economic status exacerbates the situation, because schools are experiencing financial shortages which encourage in-school commercial food provision such as vending machine and fast food sales (Levine, 1999; Parsad & Lewis, 2006). Vending machines filled with nondairy beverages and
snack food items are accessible during lunch, during the school day, and outside of school 33%, 46% and 61% of the time, respectively (Parsad & Lewis, 2006). Rural schools offer vending machines in a higher proportion, and these are filled with more snack-type foods compared to schools located in urban or city settings (Parsad & Lewis, 2006). In 2001, approximately 20% of US high schools offered brand-name fast foods, such as Pizza Hut or Taco Bell (Wechsler, Brener, Kuester, & Miller, 2001). Despite schools’ financial reliance on vending machines, schools have the ability to ban nutrient empty food from vending machines (Silverman, 2006; Watley Blum et al., 2008). Until schools ban vending machines or offer vending machines stocked with less sugar filled options, children will continue to rely on higher calorie snacks before, during, and after school hours.

Role of School in Inactivity

Children spend a majority of their day in school, which favorably positions schools to offer periods for physical education to facilitate exercise. The percentage of high school students participating in daily physical education classes dropped from 42% in 1991 to 29% in 1999 (Freedman et al., 1999). A recent report indicates that nearly 7% to 13% of elementary schools offer no recess and 78% to 83% do not offer daily physical education (Parsad & Lewis, 2006). The majority of first- through fifth-grade students have two days of physical education per week (Parsad & Lewis, 2006). Schools with predominately students with low socioeconomic status offer less time for recess than more affluent schools (Parsad & Lewis, 2006). Schools justify decreasing physical activity because of increasing time pressure to achieve higher standardized test scores, even though daily physical activity has been shown to increase test scores and facilitate
better in-class behavior conducive for learning (California Department of Education, 2002; Shephard, 1997; Symons, Cinelli, James, & Groff, 1997).

Sixty to 90 minutes of physical activity is recommended as a positive health behavior for children (USDHH, 2005). Physical fitness, such as cardiovascular endurance and flexibility, is another important factor related to health, independent from physical activity. Children who engage in more than 40 minutes of vigorous activity each day have greater cardiovascular fitness and lower body fat compared to children who engage in less than 18 minutes a day (Ruiz et al., 2006). Thirty minutes a day of school physical education has been shown to lower rates of overweight status and to improved physical fitness levels in students (Christodoulous, Flouris, & Tokmakidis, 2006).

Due to the health benefits of daily physical activity, parents and teachers have started campaigning for more activity time in schools. These parents and teachers advocate that school-based physical education is an opportunity to fulfill health-related fitness needs of all children (The National Parent Teacher Alliance [NPTA], 2007). The NPTA, (2007) has implemented a “Rescuing Recess” campaign, to encourage recess across schools in the United States. Senator John Cornyn introduced legislation to amend the No Child Left Behind Act to provide minimum standards for health and fitness in schools (NPTA, 2007). Two states, Michigan and Virginia, have already mandated time for recess statewide (NPTA, 2007).

Dietary Recommendations

Adequate nutrition during childhood is essential for growth and development, health, and well-being. In 2005, the United States Department of Agriculture (USDA)
released an updated version of the Food Guide Pyramid called MyPyramid (USDA, 1992; USDA, 2006). MyPyramid emphasizes variety, proportionality, moderation, and activity based on intake recommendations for 12 different population groups to meet Recommended Dietary Allowances (RDAs) or Adequate Intakes (AIs) (USDA, 2006). RDAs are defined as the dietary intake level that is sufficient to meet the nutrient requirements of 97% to 98% of individuals in an age or gender group (USDHH, 2005). AIs are recommended amounts to sustain good health. AIs have been established for nutrients in which there are not enough scientific evidence to set an RDA (USDHH, 2005).

Dietary moderation and variety are promoted in MyPyramid, because excessive intake of one food can hinder intake of nutrients lacking in that food; for example, an over-consumption of cow’s milk may lead to iron deficiency (Gunnarsson, Thorsdottier, & Palsson, 2007; Thorsdottier & Gunnarsson, 2006). Servings in the new system are measured by volume or weight (i.e., 6 ounces of grains a day, 2 ½ cups of vegetables a day). Each population group has a specific food pattern based on certain caloric levels (1,000 to 3,200 kcal). These food patterns are targeted to meet varying nutrient needs according to age, gender and activity level of population groups.

MyPyramid recommendations for an average 7- to 8-year-old child include: 1800 calories a day, emphasis on dark green and orange vegetables, limited fruit juice intake, consumption of low fat or fat free dairy, and emphasis on lean or low fat meat choices. Children in this age group should consume 6 ounces of grains (at least 3 ounces whole grain), 2.5 cups vegetables, 1.5 cups fruit, 2 cups dairy, and the equivalent of 5 ounces meat or meat alternatives on a daily basis. By consuming recommended servings from
each food group, the child is likely to meet nutrient needs; therefore, tracking intake of food groups is an effective means to assess adequacy of nutrient consumption.

Nutritional Deficiencies Common in Children

Over time, if recommended intakes are significantly below 75% of the RDA recommended value, an individual may risk marginal status in vitamins, minerals, and/or fiber. The US Department of Health and Human Services (USDHH) indicates nutrients of concern for children are calcium, potassium, fiber, magnesium, and vitamin E (USDHH, 2005). Recommended fiber intake for children is 14 grams per every 1,000 calories of energy consumed (25 grams for 1800 calories); (USDHH, 2005); based upon analysis of NHANES III data, 2- to 18- year-olds may be consuming less than half this amount (Alaimo, et al., 1994). Approximately 2% of 6- to 11- year-old children exhibit iron deficiency; however, iron deficiency in children 2 to 16 years increased from 2% to 5%, and almost 6% as BMI increased from normal, to being at risk for overweight, to overweight respectively (Nead, Halterman, Kaczorowski, Auiger, & Weitzman, 2004). Given the increasing number of overweight children and adolescents it seems prudent that youngsters should be scrutinized for iron sufficiency. Data obtained from the Continuing Survey of Food Intakes by Individuals (CSFII) indicate that children consume ≤ 67% of their recommended level of calcium, vitamin E, iron, and zinc (Ganji, Hampl, & Betts, 2003).

As discussed, the nutrients fiber, calcium, iron, zinc, potassium, magnesium, and vitamin E are of concern for the child population (Ganji et al., 2003; Nead et al., 2004; USDHH, 2005). Table 4 provides RDAs or AIs of these nutrients in children.
Table 4

*Recommended Dietary Allowances or Adequate Intakes for Children 4- to 8- Years Old*

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>RDA or AI per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiber</td>
<td>25 g</td>
</tr>
<tr>
<td>Calcium</td>
<td>800 mg*</td>
</tr>
<tr>
<td>Iron</td>
<td>10 mg</td>
</tr>
<tr>
<td>Zinc</td>
<td>5 mg</td>
</tr>
<tr>
<td>Potassium</td>
<td>3.8 g*</td>
</tr>
<tr>
<td>Magnesium</td>
<td>130 mg</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>7 mg*</td>
</tr>
</tbody>
</table>


These vitamins and minerals are found in a variety of fruits, vegetables, whole grains, and protein (meat and beans) sources (USDA, 2006). Dairy and vegetables (especially dark green and leafy vegetables) are excellent sources of calcium (USDA, 2006). Fiber intake corresponds to the daily number of fruit, vegetable and whole grain servings eaten (Kranz, Mitchell, Siega-Riz, & Smiciklas-Wright, 2005). Despite the abundance of nutrients found in fruits and vegetables, only 10% of girls 4- to 8-years old and 14% of boys 4- to 8-years old, eat the recommended serving amounts on a daily basis
Breakfast skipping and sweetened beverage consumption are linked to reduced servings of milk and whole grains, which will correspondingly limit calcium and fiber intake (Borrud et al., 1996; Bowman et al., 2004; Harnack et al., 1999; Kranz, Smiciklas-Wright, Siega-Riz, & Mitchell, 2005; Lee & Reicks, 2003; Nicklas et al., 2000; Ortega, et al., 1998; Rajeshwari et al., 2005). Consumption of fruits, vegetables, dairy, whole grains, and sugar can be used to help assess adequacy of dietary intake; therefore, this research study included these food groups in the nutritional lesson plans (see Appendix F).

Intervention

Prevention and treatment of overweight development may be somewhat easier in children than in adults because children are still growing rapidly (Behrman, Kliegman, & Jenson, 1996) and negative dietary habits are developing (Grainger, 1991). Three levels of prevention efforts in children are: primary, secondary, and tertiary (ADA, 2006). Primary prevention occurs before the child is overweight (ADA, 2006), and has been shown to be potentially more effective than treatment after the gain has occurred (ADA, 2006; Russell, Williamson, & Byers, 1995). Research indicates that after weight gain has occurred at any time during the elementary period, there is an 80% chance these children will be overweight at 12 years of age (Nader, et al., 2006). Primary prevention often includes additional interventions such as techniques targeting cardiovascular disease or diabetes prevention.

Secondary prevention includes efforts involving identification and intervention of asymptomatic children who are at risk for overweight; these interventions are specifically designed with changing weight status as the main outcome (ADA, 2006). When
addressing primary and secondary prevention, an intervention should include a multi-
component school- and family-based approach which includes a combination of physical
activity, parent training, parent modeling, behavior counseling and nutrition education
(ADA, 2006). Appendix F provides examples of interventions implemented in
elementary schools using both exercise and nutrition education for prevention purposes.

Although most of these studies had strong designs, the results of these primary
preventions on childhood overweight have had disappointing results. Of these multi-
component programs, The Child and Adolescent Trial for Cardiovascular Health
(CATCH) program is one that has been rigorously evaluated with multiple articles
describing various outcomes. Despite disappointing results in weight measurements after
the four year intervention, significant differences were found in total calorie consumption
and percent of calories derived from total and saturated fats (Osganian, et al., 1996). In
addition to insignificant changes in BMI, physical activity components in the CATCH
study were not successful at increasing activity (Luepker, et al., 1996).

The Pathway study, similar to the CATCH Study, was an extensive three-year
secondary prevention study conducted with third- through fifth-grade Native American
children (Caballero, et al., 2003). The study was conducted in 41 elementary schools in
three states with a multi-component approach that included foodservice, classroom
nutrition education, physical activity, and parental involvement (Caballero et al., 2003).
The nutrition curricula consisted of two 45-minute classroom nutrition lessons each week
for 12 weeks during third and fourth grade and 8 weeks during fifth grade. Additionally,
packets of nutrition information were sent home to parents (Caballero et al., 2003).
Physical education classes were adjusted to better relate to Native American cultural
traditions, and opportunities for physical activity were increased (Caballero et al., 2003). The intervention resulted in no significant reduction in percentage body fat or activity levels; however, certain components of knowledge, attitudes, and behaviors were significantly changed (Caballero et al., 2003; Going, et al., 2003). The Pathway study provides strong evidence that classroom education can improve the health knowledge and attitudes of students.

A unique aspect of the Pathway study was the inclusion of both a school-based and family-based intervention technique. Although many studies have used the multi-component approach based in schools, few have extended it towards families as well. Two parallel primary intervention studies were conducted including exercise and nutrition with both school and family involvement (Hopper, Gruber, Munoz, & Herb, 1992; Hopper, Gruber, Munoz, & MacConnie, 1996). These studies focused on second, fourth, fifth and sixth graders with two half-hour nutrition education sessions per week over the course of 6 and 10 weeks (Hopper et al., 1992; Hopper, et al., 1996). The nutrition lesson involved types of fat and cholesterol and included: preparing snacks, using fruits and vegetables, preparing heart healthy meals, reading labels, fiber containing foods, meat alternatives and high energy foods (Hopper et al., 1992; Hopper et al., 1996). Family nutrition education packets were sent home for parents. Packets included directions for healthy meal preparation and a corresponding set of activities to enhance family physical activity (Hopper et al., 1992; Hopper et al., 1996). Although no significant changes in body composition occurred, results showed that children completing both school and home education components had improvements in flexibility and nutrition knowledge (Hopper et al., 1992; Hopper et al., 1996). Again, this study
proposes the idea that early education of healthy eating behaviors may impact future health attitudes and behaviors.

Tertiary prevention targets already overweight children (ADA, 2006) and should be handled carefully to avoid affecting children’s food preferences, initiating disordered eating patterns (Birch & Fisher, 1998; Fisher & Birch, 1999; Fisher & Birch 2002; Robinson, Kiernan, Matheson, & Haydel 2001), or further exacerbating body dissatisfaction (Tulkki et al., 2006). For weight reduction, it is recommended that a parent needs to offer a variety of healthy foods and allow children to control whether and how much they eat (Birch, Fisher, & Grimm-Thomas, 1996). Restrictive feeding practices only increase children’s desire to consume restricted foods, even in the absence of hunger which can lead to weight gain (Fisher & Birch, 2000, 2002; Robinson et al., 2001). To prevent restrictive feeding outcomes, parents or caregivers should create flexible, yet structured, eating environments for children to make reasonable decisions about food intake.

Summary

From the 1970s to 2004, incidence of overweight in American children ages 6 to 11 years old has more than quadrupled. Research has shown that overweight children are likely to suffer from a vast number of psychological, social, and medical complications. Development of overweight status in childhood is influenced by a wide range of environmental factors such as dietary intake, advertising influences, information communication technology, parental role modeling, and school influences. The American Dietetic Association recommends prevention of excess weight gain rather than treatment. The goal of prevention should ensure adequate nutrient intake by encouraging
healthy eating habits rather than weight loss. A limited number of studies have focused on a family, school-based, multi-component prevention program in children as young as 7 and 8 years of age. No published studies were found to have implemented this type of prevention in rural Appalachian children. Rural Appalachia is a region of the U.S. that is subject to higher incidence of poverty, obesity, and health disparities, which makes this study essential. The goal of this study was to establish a new research design for early overweight intervention among rural Appalachian children. Because a prevention study was implemented, the implications of this research can not be determined until the children in this study are examined in the future.
CHAPTER 3: METHODS

Methodology

This study was a 16-week multi-component project involving nutrition education for both the children and their families in addition to incorporating an in-school exercise rowing program. The study was designed to assess nutritional intake and body composition. Interdisciplinary researchers were involved in data collection from January 2007 to May 2007.

A limited number of studies have included a multi-component approach as an intervention to prevent overweight development in Appalachian children. In particular, no studies of children living in rural Appalachia, Ohio have incorporated this approach. The purpose was to prevent development of overweight in rural second grade children 7 to 8 years of age by promoting physical activity and recommended dietary behaviors. The study supported existing programs currently being implemented in the selected schools, such as the USDA fruit and vegetable grant and daily classroom calisthenics. It was hypothesized that nutrition education of the child will result in healthier dietary behaviors evidenced by intake of nutrients recommended by MyPyramid food groups. In addition, it was hypothesized that a 16-week nutrition education and exercise intervention would promote significant changes in body composition. Approval for the study was obtained from the Federal Hocking School Board and the Institutional Review Board of Ohio University (see Appendix G) prior to the beginning of data collection.
Sample

Recruitment of participants was on a volunteer basis from Federal Hocking 2nd-grade classes at Amesville (experimental group) and Coolville (control group) elementary schools. Both schools are located in rural areas of southern Appalachia, Ohio.

Approval was granted by the Federal Hocking School Board and administrators. Investigators met with parents or guardians to explain the purpose, methods, and procedures of the study. Both verbal and written assent were obtained from prospective participants. Written permission was obtained from their parents or guardians.

Children participating in the study were enrolled in the selected schools from January 2007 through May 2007. Approximately 70% of the children participating in the study were on free or reduced lunches, and these children were also offered free breakfast daily. Greater than 60% of the participants’ families lived at or below the federal poverty level during our study. All participants had an unremarkable medical history. Sample size included 19 participants in the experimental group and 16 participants in the control group. Children in 2nd-grade classrooms without verbal and written consent were excluded from the study. However, all 31 2nd-grade students in the experimental group were able to participate in the nutrition lessons and exercise training sessions, because these sessions were considered part of the 2nd-grade science and physical education curricula.

Pre- and Post- Testing Procedures

A ten-minute information session with each child’s parents occurred prior to the pre-test session and experimental intervention. Informed consent (see Appendix I) and medical history (see Appendix J) forms were presented to parents; a pictorial flow chart
(see Appendix K) was provided to help explain the study. The take-home flow chart included important dates and a stamped envelope for return of the informed consent and medical history forms. A brief summary of pre-test activities was attached to the flow chart. Using the Simple Measure of Gobbledygook (SMOG) readability calculator, the flow chart and summary were calculated at an 8th-grade reading level (McLaughlin & Trottier, 2006). Parents were given the opportunity to sign up for an after school pre-testing time slot in January, and the corresponding date was recorded on their take-home flow chart. Packets of information were sent home to parents not able to attend the information session. Reminder phone calls and mailings to parents occurred the week prior to selected pre-test dates. Grocery store gift cards and a light supper were provided to encourage parents to attend assigned pre-testing dates and t-shirts were provided to the subjects to encourage full participation. Post-testing procedures paralleled pre-testing procedures.

Pre-test and post-test data collection occurred over three days for each school. To facilitate efficiency, testing information was collected at three distinct stations by trained personnel. Participants were allocated 15 minutes to rotate through each station. Information and testing stations included a medical station, a food record instruction station, and an exercise test station. Children were accompanied by a parent or guardian at each station.

At the medical station, each child was examined by a pediatrician. Prior to the examination, the pediatrician obtained a medical approval form and medical history form from each child’s parent or caregiver. These forms were documented and reviewed prior to the physical examination. After the medical examination, trained assistants gathered
anthropometric data (height and weight) and measured skin fold thickness to determine body composition.

At the food record instruction station, registered dietitians provided in-depth instructions to parents on recording their child’s intake in a food record. This incorporated a variety of teaching methods to accommodate different learning styles. This station provided three specific dates (two weekdays and a Saturday) during which investigators would be recording foods consumed by participants at school with parents doing the same at home.

Each child and their accompanying parent or guardian attended the medical station prior to the exercise test station. Before the exercise testing, in an instructional session, participants were taught the proper rowing technique, and were given the opportunity to become accustomed to the respiratory equipment (breathing mask) and exercise equipment. Exercise physiologists measured aerobic fitness, heart rate, blood pressure, and respiratory functions.

Measurements

Dietary, anthropometric, and physiologic measurements were obtained in the winter of 2007 at baseline, and follow-up occurred in the spring of 2007. Overweight status was defined using the CDC cutoffs for BMI at the 95th percentile (kg/meters squared). Participants were weighed before their evening meal. Body weights were recorded with a Seca (model 671) mechanical scale accurate to ± 0.1 kg (Seca, 2009). Subjects were instructed to wear standard gym shorts and T-shirts. Height was measured without shoes using a standard yard stick affixed to a wall, 24 inches from the ground. A ruler was placed horizontally atop the child’s head to base the angle for precise height
measurement. Body composition was determined using Harpenden skinfold calipers to measure the skinfold-thickness at six sites: subscapula, pectoral, umbilicus, triceps, suprailiac, and thigh (Hagerman, 1984). According to documented procedures, all skinfold-thickness measurements were taken in triplicate by the same trained research assistant and with the same (Harpenden) calipers (Jackson & Pollock, 1985). Age and gender appropriate regression equations were used to determine percent body fat (Hagerman, 1984).

**Nutrition Assessment**

Nutrition assessment was conducted during the pre- and post-intervention period via a three-day food record, a common and valid technique used for tracking dietary intake in children (Bandini, Cyr, Must, & Dietz, 1997; Crawford, Obarzanek, Morrison, & Sabry, 1994). A three-day food record was selected over a seven-day period to minimize quality decline and altered food habits (Black, et al., 1993; Trabulsi & Schoeller, 2001). Dates for recording three-day food logs included two weekdays and one weekend day. To maximize accuracy, skilled dietetic investigators monitored food intake on a recording form (see Appendix L) for children during school breakfast and lunch periods, on the two weekdays. Children are not considered reliable data collectors until 10 to 12 years of age when serving as their own respondents (Frank, 1991). For this reason, parents were asked to accurately fill out a food record for their child outside of school. A set of instructions (see Appendix M), including common serving sizes and equivalents, was attached to the food recording form to provide guidance on quantifying dietary intake. Plasticene food models, measuring cups, and measuring spoons were used to teach parents how to accurately track and log on the food record form. Food models
were chosen to be culturally representative and age appropriate for the population, a priority identified by participants at the First International Conference on Dietary Assessment Methods (Buzzard & Sievert, 1994). Dietitians reviewed with parents commonly underreported or inaccurately reported foods such as condiments, type of milk, cooking oil used, and type of meat in meat mixtures (Krebs-Smith et al., 2000). To minimize underreporting, subjects were asked to maintain usual intakes and the importance of accuracy was emphasized (Briefel, Sempos, McDowell, Chien, & Alaimo, 1997).

Several types of reminders were used to encourage completion and return of the food records. Dates on which food intake was to be recorded were printed on each page of the food record and a stamped returned address envelope was provided. A reminder letter was sent home with students to prompt parents of food recording dates. If the child was sick during selected recording dates, parents were instructed to record intake on an alternative date. If a food record was not returned, follow-up phone reminders were conducted. Grocery store cards were given upon return of completed food records.

Food records were entered into the Nutritionist Pro™ Nutrition Analysis Software Version 1.3 using a developed protocol to standardize food entry (Axxya Systems, 2006). This nutrient database program provided nutrient values for over 20,000 brand name, generic, and fast foods (Axxya Systems, 2006). New food items and recipes were entered into the nutrient data base as needed. Both nutrient intake and MyPyramid food groups were analyzed by the program (Axxya Systems, 2006). Nutrient analysis was based on number of daily servings from fruit, vegetable, and dairy food groups in MyPyramid and percent attainment of age specific Recommended Dietary Allowances.
(RDA) or Adequate Intakes (AI) for fiber, calcium, iron, zinc, magnesium, potassium, and vitamin E. Grams of sugar intake were also assessed over the recording period.

Dietary Interventions

A lesson plan was developed outlining main educational objectives and related activities for each food experience. Objectives were developed in consultation with dietitians and early education teachers. Food safety and sanitation concepts were incorporated into each session.

The intervention consisted of six 45- to 60-minute food and nutrition encounters that occurred in each of two experimental 2nd-grade classes. These occurred over a 16-week period. Researchers aimed for one lesson per week; however, at the time of the study there were multiple snow days and only six nutrition encounters were achieved. Each encounter introduced a food experience related to vegetables, fruits, whole grains, healthy beverages, protein, and building a healthy meal. Food experiences were based on MyPyramid for children and families found at http://www.mypyramid.gov/kids/index.html. The goals of the nutrition encounters were to increase the children’s awareness, knowledge, and interest in healthy eating. To ensure goals were met, the classrooms employed the help of volunteers to aide in lesson plans. The research team provided one volunteer “teacher” for every three children. With the student-to-teacher ratio of 1:3, the encounters provided ample opportunities to develop positive health behaviors through stories, games, hands-on demonstrations, interactive discussions, investigative observations, food preparation, and taste testing.

Learning was assessed by completion of activities, child participation, and the ability to answer questions. Binders conveying nutrition information were provided to
classrooms, which also included activities and recipes (see Appendix F). Teachers were encouraged to use binders for review with students prior to nutrition food encounters.

The parents of the experimental subjects attended three nutrition education encounters at the school during pre-testing, post-testing, and an evening meeting. Parents also received five packets containing nutritional information, cooking tips, and food activities for their child at home. Nutrition encounters for parents were designed to reinforce and extend experiences created for their child at school. At the end of the study, parents of the experimental participants were given an exit interview questionnaire to provide feedback for investigators (see Appendix N). The exit questionnaire was given verbally to parents by researchers. Researchers wrote down responses and recorded comments to be used in the results section.

Exercise Component

Participants in both the experimental and control groups were required to perform a maximal rowing test on a Concept 2 rowing ergometer prior to and following the 16-week exercise intervention. Each subject was fitted with a heart rate monitor belt around the chest and a combined mask and pneumotachometer so that heart rate and expired air could be measured at rest and during maximal exertion. The exercise test consisted of a 5-8 min of continuous rowing beginning at 30 watts and making a 10-watt increment every minute until either the subject terminated the exercise or maximal exercise had been achieved. The latter was determined based on the VO2 either reaching a plateau or decreasing, or an RER of 1.2, or due to volitional fatigue.

Prior to exercise testing, each participant performed a series of rowing familiarization trials on the ergometer and practiced using the heart rate belt and mask. A
MedGraphics 2000 computerized instrumentation was used to measure pulmonary ventilation and to determine fractional concentrations of oxygen and carbon dioxide, and these data were used to calculate volumes of oxygen consumption and carbon dioxide production.

Following the pre-testing for both groups of participants, the experimental group engaged in a 16-week rowing ergometer exercise training program twice weekly for 30 minutes. The exercise intensity for the exercise sessions were individualized based on the subject’s maximal power output achieved during the pre-test. Duration and intensity of exercise was increased gradually for each participant and by the completion of exercise training each child was to accomplish 10 to 15 minutes of rowing between 80 and 90% of their pre-training maximal power output. Control group participants were required to not change any of their current dietary or exercise habits during the 16-week study period. The maximal rowing ergometer exercise test was repeated for both groups of participants following the 16-week training period.

Data Analysis Plan

Data from all 2nd-graders assigned to the intervention were grouped together, as were data from the 2nd-graders assigned to the control condition. Statistical analyses were performed using Statistical Package for the Social Sciences (SPSS version 12.0, 2003, Chicago, IL) for Windows. This study used independent samples t-tests to determine if groups differed in the pre-post intervention measures, including the intake of MyPyramid food groups, selected nutrients, fiber, grams of sugar, and total energy consumption before and after treatment. Independent samples t-tests were also
implemented to test if differences in body composition before and after treatment were different between groups. Differences were considered significant at p \leq 0.05.
CHAPTER 4: RESULTS

Data Collection and Survey Response

The main objective of this study was to investigate the effect of a 16-week exercise and nutrition program involving participation of the schools, participants, and families. The nutrition education and exercise program took place between January and May of 2007. Specifically, this study was designed to determine if there were significant differences in children’s dietary behaviors, BMI, and percent body fat after the intervention.

In order to analyze the significance of an exercise and nutrition intervention, 2nd-grade children (n = 35) were selected from two classrooms in two separate rural schools in the Federal Hocking school district. Coolville’s 2nd-grade classroom was assigned as the control group (n=16) and Amesville’s 2nd-grade classroom, as the experimental group (n=19). The 35 participants consisted of 17 girls (n = 8 in control; n = 9 in experimental) and 18 boys (n = 8 in control; n = 10 in experimental).

Anthropometric data (height, weight, BMI, percent body fat) were gathered before and after the program, although only 12 control group and 17 experimental group children were measured after the program. Of those 35 children, 26 (74.3%) also completed a food record before and after the study to assess the children’s nutrient intake, of which 9 children were in the control group and 17 children were in the experimental group.

Male children made up the majority of total participants who completed a food record (n = 15; 57.7%), pre anthropometric data (n = 18; 51.4%), and post anthropometric data (n= 16; 55.2%). Of the 15 males completing both pre- and post-
anthropometric testing, 9 (60%) were from the experimental group and 7 (46.7%) were from the control group. The frequencies and percentages of the categorical variables (grouping and gender) describing the sample are shown in Table 5.

Table 5

*Frequencies and Percentages of Grouping and Gender*

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender (Food Record Completion)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>11</td>
<td>42.3</td>
</tr>
<tr>
<td>Male</td>
<td>15</td>
<td>57.7</td>
</tr>
<tr>
<td><strong>Grouping (Food Record Completion)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>9</td>
<td>34.6</td>
</tr>
<tr>
<td>Experimental</td>
<td>17</td>
<td>65.4</td>
</tr>
<tr>
<td><strong>Grouping (Anthropometric Data)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>16</td>
<td>45.7</td>
</tr>
<tr>
<td>Experimental</td>
<td>19</td>
<td>54.3</td>
</tr>
</tbody>
</table>

*Hypothesis 1: Nutrition Education Will Positively Impact Children’s Dietary Behaviors*

This hypothesis was tested by conducting independent samples t-tests on the change in children’s dietary behaviors. The change is represented as the difference between the value after the program and the value before the program. It is represented
this way in order to judge whether the experimental group was impacted significantly by
the intervention as opposed to random fluctuations in the values. An independent samples
t-test compares the mean scores of two groups on a given variable. Thus, it is used to
determine if the mean of some outcome variable is significantly different between two
independent groups, such as an experimental and control group.

The independent samples t-test revealed that there were significant differences
between the amount of magnesium ingested ($t(24) = -2.391, p = .025$) and the amount of
milk ingested ($t(24) = -2.362, p = .027$). In both cases, children in the experimental group
increased their intake of milk and magnesium while the children in the control group
actually decreased their intake of milk and magnesium. The differences in the other
nutrients and foods were not significant at the 5% level. Based on these results, the null
hypothesis can be partially rejected. The experimental group did engage in better dietary
practices after the program. However, it should be noted that of the 17 children in the
experimental group, only 35.3% showed a decrease in potassium intake after the
program, while for the control group, 66.7% showed a decrease in potassium intake after
the program. Table 6 depicts the changes in dietary behavior between the control and the
experimental group.
Table 6

*Differences in the Changes in Dietary Behavior Between the Control Group and the Experimental Group*

<table>
<thead>
<tr>
<th>Component</th>
<th>Group</th>
<th>N</th>
<th>Mean Difference (Post-Pre)</th>
<th>SD</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiber (g)</td>
<td>Control</td>
<td>9</td>
<td>-2.7</td>
<td>5.3</td>
<td>.227</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>17</td>
<td>.6</td>
<td>7.1</td>
<td></td>
</tr>
<tr>
<td>Vitamin E (mg)</td>
<td>Control</td>
<td>9</td>
<td>-.2</td>
<td>0.8</td>
<td>.835</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>17</td>
<td>-.3</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>Potassium (mg)</td>
<td>Control</td>
<td>9</td>
<td>-108.4</td>
<td>630.3</td>
<td>.153</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>17</td>
<td>267.9</td>
<td>611.2</td>
<td></td>
</tr>
<tr>
<td>Calcium (mg)</td>
<td>Control</td>
<td>9</td>
<td>-160.8</td>
<td>232.3</td>
<td>.176</td>
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<tr>
<td></td>
<td>Experimental</td>
<td>17</td>
<td>2.8</td>
<td>307.1</td>
<td></td>
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<tr>
<td>Iron (mg)</td>
<td>Control</td>
<td>9</td>
<td>-3.2</td>
<td>10.1</td>
<td>.287</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>17</td>
<td>.0</td>
<td>5.4</td>
<td></td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>Control</td>
<td>9</td>
<td>-29.9</td>
<td>60.5</td>
<td>.025*</td>
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<tr>
<td></td>
<td>Experimental</td>
<td>17</td>
<td>28.2</td>
<td>58.2</td>
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<tr>
<td>Zinc (mg)</td>
<td>Control</td>
<td>9</td>
<td>-1.2</td>
<td>7.5</td>
<td>.363</td>
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<tr>
<td></td>
<td>Experimental</td>
<td>17</td>
<td>.9</td>
<td>3.9</td>
<td></td>
</tr>
<tr>
<td>Vegetable Serving</td>
<td>Control</td>
<td>9</td>
<td>0</td>
<td>0.7</td>
<td>.625</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>17</td>
<td>-.1</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td>Fruit Serving</td>
<td>Control</td>
<td>9</td>
<td>.3</td>
<td>0.6</td>
<td>.513</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td>17</td>
<td>.1</td>
<td>0.7</td>
<td></td>
</tr>
</tbody>
</table>
### Hypothesis 2: Body Composition Will Significantly Change After the Nutrition and Exercise Program

Independent samples t-tests were conducted on the change in the children’s BMI and change in percent body fat. The changes in anthropometrics were examined with respect to the children’s grouping. The change in the experimental group is compared to the change in the control group to see whether the program impacted the values or if differences were due to random fluctuation.

The independent samples t-test revealed no significant differences between groups. None of the other variables were significantly impacted at the 5% level by the nutrition and exercise program. Based on these results, the null hypothesis cannot be rejected. However, after the intervention, the experimental group’s BMI appeared to change for the better as compared to the control group. It is interesting to note that, of the 12 children in the control group whose measures were taken after the program, 3 showed...
a decrease in BMI of 1.79, 1.54 and 1.28, resulting in an overall mean difference that was less after the program. Table 7 depicts the differences in body composition changes between the control and experimental group.

Table 7

_Differences in the Changes in Body Composition Between the Control Group and the Experimental Group_

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean Difference (Post-Pre)</th>
<th>SD</th>
<th>Difference</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>17</td>
<td>.8</td>
<td>.9</td>
<td>.466</td>
</tr>
<tr>
<td>Control</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>17</td>
<td>2.9</td>
<td>2.4</td>
<td>.489</td>
</tr>
<tr>
<td>Control</td>
<td>12</td>
<td>4.0</td>
<td>5.52</td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>17</td>
<td>.4</td>
<td>1.0</td>
<td>.133</td>
</tr>
<tr>
<td>Control</td>
<td>12</td>
<td>-.2</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>BF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>15</td>
<td>.4</td>
<td>2.3</td>
<td>.962</td>
</tr>
<tr>
<td>Control</td>
<td>12</td>
<td>.4</td>
<td>2.7</td>
<td></td>
</tr>
<tr>
<td>FM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>15</td>
<td>.1</td>
<td>1.2</td>
<td>.715</td>
</tr>
<tr>
<td>Control</td>
<td>12</td>
<td>.3</td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td>FFM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>15</td>
<td>1.6</td>
<td>2.3</td>
<td>.280</td>
</tr>
<tr>
<td>Control</td>
<td>12</td>
<td>.8</td>
<td>1.1</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* BF = body fat; FM = fat mass; FFM = fat free mass.
Descriptive Statistics

Descriptive statistics discussed in the section are not significant but are observations made by the investigator. Chapter 2, table 4 displayed the RDA or AI for 4- to 8-year-old children in regards to intake of fiber, calcium, iron, zinc, potassium, magnesium and vitamin E. Based on mean intake values obtained, both groups were below the RDA or AI for fiber, vitamin E, and potassium. Chapter 2 provided the recommended servings for vegetables (2.5 cups), fruit (1.5 cups), and milk (2 cups). Based on mean intake values, both groups were below these recommendations for fruits and vegetables.

Control participants’ intake of fiber decreased after the 16-week intervention period from 55.6% to 44.8% of the recommended amount. Intake of fiber in experimental participants was below recommended levels before and after nutrition education; however, percentage of the recommended levels increased from 58.8% to 61.6% at the conclusion of the 16 weeks. Potassium intake followed the same trends as fiber. Both group’s baseline consumption of potassium was considered inadequate. Concurrently, control subjects’ intake decreased (56.6% to 53.7% of RDA) while experimental subjects’ intake increased (49.5% to 56.6%) over the course of the study. Intake of vitamin E further decreased below the RDA in both groups. The decrease was 0.2 mg (24.2% of RDA) in the control group and 0.4 mg (48.6% of RDA) in the experimental group. For other minerals measured before and after the intervention, intake decreased in the control group and increased in the experimental subjects.

Fruit and vegetable intake in both groups was inadequate and remained at roughly 1 serving per day before and after the intervention. At baseline, in both groups, servings
of milk were at recommended quantities for age. Intake of milk in control subjects remained stable at roughly 2.5 servings per day; however, intake in the experimental group increased by 0.5 servings a day after having nutrition education. Control subjects mean intake of sugar decreased by 9 grams over the 16 weeks; however, the proportion of intake compared to mean daily calories increased from 25.9% to 26.6%. Conversely, in experimental participants, the mean intake of sugar increased by 16.4 grams but the proportion of sugar calories remained stable at around 24%. Overall, daily mean calorie intake decreased by 187 calories in control participants and increased in 49 calories in experimental subjects. The means and standard deviations of variables describing intake of the participants are presented in Table 8.

The average age of the participants at the start of the study was 7.6 years ± 0.5 years and the average age of the participants at the end of the 16 weeks was 7.7 years ± 0.5 years at Coolville and 7.9 years ± 0.2 years at Amesville. The means and standard deviations of variables describing anthropometric data and age of participants are presented in Table 9.
Table 8

*Descriptive Statistics for Children’s Dietary Measures*

<table>
<thead>
<tr>
<th></th>
<th>Control (N = 9)</th>
<th></th>
<th>Experimental (N = 17)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre M SD</td>
<td>Post M SD</td>
<td>Pre M SD</td>
<td>Post M SD</td>
</tr>
<tr>
<td>Fiber (g)</td>
<td>13.9 4.6</td>
<td>11.2 1.3</td>
<td>14.7 5.3</td>
<td>15.4 6.0</td>
</tr>
<tr>
<td>Vitamin E (mg)</td>
<td>1.9 3.2</td>
<td>1.7 .7</td>
<td>3.8 .6</td>
<td>3.4 2.4</td>
</tr>
<tr>
<td>Potassium (mg)</td>
<td>2154.9 604.4</td>
<td>2046.5 536.7</td>
<td>1879.3 716.6</td>
<td>2147.2 720.1</td>
</tr>
<tr>
<td>Calcium (mg)</td>
<td>1025.6 279.6</td>
<td>864.8 268.2</td>
<td>885.8 283.7</td>
<td>888.6 228.7</td>
</tr>
<tr>
<td>Iron (mg)</td>
<td>15.4 3.6</td>
<td>12.2 4.8</td>
<td>13.6 8.4</td>
<td>13.7 4.5</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>189.8 42.6</td>
<td>159.9 29.9</td>
<td>156.9 60.6</td>
<td>185.2 55.6</td>
</tr>
<tr>
<td>Zinc (mg)</td>
<td>10.0 3.8</td>
<td>8.8 2.2</td>
<td>7.9 6.9</td>
<td>8.7 2.6</td>
</tr>
<tr>
<td>Servings of</td>
<td>.9 .6</td>
<td>.9 .5</td>
<td>1.1 .4</td>
<td>.98 .5</td>
</tr>
<tr>
<td>Vegetables Servings</td>
<td>.8 .6</td>
<td>1.1 .6</td>
<td>.9 .5</td>
<td>1.0 .7</td>
</tr>
<tr>
<td>Fruit</td>
<td>2.7 .7</td>
<td>2.4 .9</td>
<td>1.9 1.1</td>
<td>2.4 .7</td>
</tr>
<tr>
<td>Servings of Milk</td>
<td>120.1 37.8</td>
<td>111.1 27.5</td>
<td>113.5 7.2</td>
<td>117.6 33.9</td>
</tr>
<tr>
<td>Sugar (g)</td>
<td>1857.4 383.9</td>
<td>1670.8 324.1</td>
<td>1888.5 241.5</td>
<td>1937.1 445.0</td>
</tr>
<tr>
<td>Calorie Intake</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 9

*Descriptive Statistics for Children’s Anthropometric Data*

<table>
<thead>
<tr>
<th></th>
<th>Control Pre (N=16)</th>
<th>Post (N=12)</th>
<th>Experimental Pre (N=19; *N=18)</th>
<th>Post (N=17; *N=16)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Height (ins)</td>
<td>51.0</td>
<td>2.3</td>
<td>52.2</td>
<td>1.9</td>
</tr>
<tr>
<td>Weight (lbs)</td>
<td>66.5</td>
<td>19.0</td>
<td>71.6</td>
<td>21.3</td>
</tr>
<tr>
<td>BMI</td>
<td>18.3</td>
<td>4.62</td>
<td>18.4</td>
<td>4.7</td>
</tr>
<tr>
<td>% BF</td>
<td>8.8</td>
<td>5.1</td>
<td>10.1</td>
<td>5.8</td>
</tr>
<tr>
<td>FM</td>
<td>3.0</td>
<td>2.6</td>
<td>3.7</td>
<td>3.5</td>
</tr>
<tr>
<td>FFM</td>
<td>27.7</td>
<td>6.3</td>
<td>28.8</td>
<td>6.3</td>
</tr>
<tr>
<td>Age in years</td>
<td>7.6</td>
<td>.5</td>
<td>7.7</td>
<td>.5</td>
</tr>
</tbody>
</table>

*Note.* BMI = body mass index; BF = body fat; FM = fat mass; FFM = fat free mass; M = mean; SD = standard deviation.
BMI of Subjects

BMI was calculated on all 35 subjects at the start of the study and 29 (82.9%) at the end due to subject withdrawal. BMI ranged from 12.6 to 37. Two subjects (0.6%) had a BMI below the 5th percentile (underweight) at the start and at the end of the study. The majority of participants had an acceptable BMI between the 5th and 85th percentile for their age and sex, pre (n = 25, 71.4%) and post (n = 20, 69%) intervention. The remaining subjects had a BMI between the 85th and 95th percentiles (n = 3 and 3; 8.57% and 10.3%) classifying them as “at risk for overweight” or a BMI greater than the 95th percentile (n = 5 and 4; 14.3% and 13.8%) classifying them as “overweight.” Tables 10 and 11 summarize the BMI frequencies of male and female participants.

Table 10

BMI Percentiles of Male Participants (n = 18 Pre and 16 Post)

<table>
<thead>
<tr>
<th>Percentiles</th>
<th>Pre-Testing</th>
<th>Post-Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percent</td>
</tr>
<tr>
<td>&lt;5</td>
<td>2</td>
<td>11.1</td>
</tr>
<tr>
<td>5-84</td>
<td>12</td>
<td>66.7</td>
</tr>
<tr>
<td>85-94</td>
<td>1</td>
<td>5.6</td>
</tr>
<tr>
<td>&gt;95</td>
<td>3</td>
<td>16.7</td>
</tr>
</tbody>
</table>
Table 11

*BMI Percentiles of Female Participants (n = 17 Pre and 13 Post)*

<table>
<thead>
<tr>
<th>Percentiles</th>
<th>Pre-Testing</th>
<th>Post-Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percent</td>
</tr>
<tr>
<td>5-84</td>
<td>13</td>
<td>76.5</td>
</tr>
<tr>
<td>85-94</td>
<td>2</td>
<td>11.8</td>
</tr>
<tr>
<td>&gt;95</td>
<td>2</td>
<td>11.8</td>
</tr>
</tbody>
</table>

End of Study Interview Questions for Parents of Experimental Participants

At the completion of the nutrition and exercise intervention study parents were asked to complete an exit questionnaire (see appendix N). This was completed by 15 of the 19 (78.9%) parents from the experimental group. Descriptive statistics, primarily frequency data, were used to analyze these data. Eight parents (53.3%) reported receiving all five nutrition information flyers sent home with their child. Only one parent reported receiving no flyers (6.7%). Table 12 provides information regarding how many parents received nutrition flyers sent home.
Table 12

*Number of Nutrition Flyers Sent Home that Parents Received*

<table>
<thead>
<tr>
<th>Amount</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>6.7</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>13.3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>20.0</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>6.7</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>53.3</td>
</tr>
</tbody>
</table>

These flyers describe classroom food experience which has occurred. The pretzel making and whole grain flyer were deemed the most helpful (33.3%; n=5). Thirty three percent (n= 5) of parents found all the flyers sent home to be of equal importance. Table 13 summarizes the parental thoughts regarding nutrition flyers.
Table 13

*Flyers Found by Parents to be the Most Helpful*

<table>
<thead>
<tr>
<th>Category</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetable</td>
<td>1</td>
<td>6.7</td>
</tr>
<tr>
<td>Whole Grain</td>
<td>4</td>
<td>26.7</td>
</tr>
<tr>
<td>Healthy Beverages</td>
<td>1</td>
<td>6.7</td>
</tr>
<tr>
<td>All</td>
<td>5</td>
<td>33.3</td>
</tr>
<tr>
<td>Pretzel and Salad</td>
<td>1</td>
<td>6.7</td>
</tr>
<tr>
<td>No response</td>
<td>2</td>
<td>13.3</td>
</tr>
<tr>
<td>Did not review</td>
<td>1</td>
<td>6.7</td>
</tr>
</tbody>
</table>

The children had six different food experiences in their classrooms, five of which involved preparation and consumption (see Appendix F). Fourteen parents (93.3%) reported their child describing cooking lessons along with the associated nutritional principles. Table 14 describes the lessons parents reported their child explained after school.
Table 14

*Cooking Lessons Reported to Parents*

<table>
<thead>
<tr>
<th>Recipe reported</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Making a salad</td>
<td>9</td>
<td>60.0</td>
</tr>
<tr>
<td>Making a fruit parfait</td>
<td>5</td>
<td>33.3</td>
</tr>
<tr>
<td>Making a pretzel</td>
<td>11</td>
<td>73.3</td>
</tr>
<tr>
<td>Making a chicken roll-up</td>
<td>3</td>
<td>20.0</td>
</tr>
<tr>
<td>Making a pizza</td>
<td>4</td>
<td>26.7</td>
</tr>
<tr>
<td>None of the lessons</td>
<td>1</td>
<td>6.7</td>
</tr>
</tbody>
</table>

As table 14 exhibits, the children were able to describe multiple lessons to their parents. Out of the five lessons involving making a recipe, the whole grain pretzel and salad lesson appeared to be the most favorably received.

Over half (80%; n =12) of the parents changed or adopted some type of healthier eating behavior in the household after treatment. The behavior reported most frequently was overall improved healthy eating (33.3%; n = 5) followed by an increased amount of vegetables consumed (26.7%; n = 4). Table 15 provides all answers regarding types of behaviors that were adopted or changed as a result of this experience.
The majority (93.3%; n = 14) believed the time their children spent learning about basic food and nutrition principles was worthwhile. Parents were also asked what they liked least about the program and what they liked best. Thirteen parents (86.7%) did not report any experience they least enjoyed or they left the question blank. However, one parent (6.7%) did mention they least enjoyed recording food intake, and one parent (6.7%) reported she was concerned about their child’s asthma during the rowing portion of this study. With regard to to what parents liked best, 20% did not respond (n = 3), 6.7% (n = 1) enjoyed the combination of exercise and nutrition, and the 73.3% reported they enjoyed learning about proper nutrition. To conclude, the final two questions on the
questionnaire, parents conveyed concepts they wished were added or covered in greater
detail in the nutrition lessons. Suggestions included more information regarding portion
sizes, more recipes, more cooking, having Saturday morning sessions with the parents, or
they reported that nothing needed to be added.
Discussion

This study suggests that six weeks of nutrition education in a rural school can positively impact a child’s food consumption. Knowing that it is possible to positively affect a child’s food intake is critical, because it is one step to preventing overweight development among youth. Children are becoming overweight at an increasing rate in the United States and in countries around the world (Wang & Lobstein, 2006). The literature review showed that unhealthy dietary habits and physical inactivity were correlated to overweight status in children. In addition, economic status and geographic region were evaluated and determined to be risk factors for overweight development in children.

The literature indicates that economically disadvantaged children are at risk for nutrient deficiencies (Bhattacharya et al., 2004) and obesity in adulthood (Okasha et al., 2003), which makes interventions in these areas critical. Impoverished families may lack transportation to grocery stores when food supplies diminish, resulting in limited fresh fruit and vegetable consumption. Families on a food budget may not be able to purchase a variety of foods needed for adequate vitamins and minerals.

Families living in rural areas are at risk for all of the above burdens associated with poverty. In addition, there are shortages in health care professionals in rural areas, which results in residents not having proper prevention, diagnosis, or treatment of chronic diseases (United States Department of Agriculture, 2007b). In particular, children in rural Appalachia regions are at a disproportionately greater risk for becoming overweight.
which further increases the risk of acquiring chronic diseases (Cottrell et al., 2005; Demerath et al., 2003; Muratova et al., 2002; Singh et al., 2008). Students in a rural Eastern North Carolina school showed significantly higher numbers of children that were overweight or at risk for overweight compared to the national estimates provided by the CDC (CDCa, 2006; CDCb, 2006; King, Meadows, Kehner, Engelke, & Swanson, 2006). In this school, 14% of Caucasian and 23% African American students 5 to 8 years of age were classified as overweight (King et al., 2006). King and associates (2006) also indicated an association of being overweight with increased blood pressure, a risk factor for cardiovascular disease (King et al., 2006). Other chronic disease risk factors have been found in similar rural settings. In 2007, a study found 40% of rural children presented with two or more risk factors for type 2 diabetes (Adams & Lammon, 2007).

Our study took place in the Federal Hocking School District which is a rural area located in Athens County. Athens County is one of the four economically distressed Ohio counties located in the Appalachian region (see Appendix D). Residents, especially children of this area, are susceptible to poverty, chronic disease, and becoming overweight (Adams & Lammon, 2007; ARC, 2007; Cottrell et al., 2005; Demerath et al., 2003; Muratova et al., 2002; Singh et al., 2008). Children in this region are at greater risk for developing an overweight status when compared to national averages. For example, in 2002, a study conducted in Appalachia indicated 43% of students 10- to 12-years of age were at risk for overweight and 25% were overweight (Muratova et al., 2002). Another study in Appalachia determined that 45% of 5th graders (approximately 9- to 10-
years old) were at risk for overweight or were already overweight (Demerath et al., 2003).

As indicated, statistics from other research in similar areas have indicated that overweight status is more prevalent in student populations compared to findings in our study. Researchers anticipated these findings because students in the other studies were older and suspected to have previously established poor dietary and physical activity habits. Investigators from the present study did not expect to find a high prevalence of at risk or overweight children because prevention was the primary purpose. However, current literature indicates that, in the future, prevention studies conducted in rural Appalachian communities may need to be initiated at an even an earlier age, because overweight prevalence appears to be increasing in even younger children. A study published in 2005 found nearly a third (31%) of West Virginian children 4 to 6 years old were at risk or were already overweight (Cottrell et al., 2005). In addition, the rural Eastern North Carolina study found 14% of Caucasian and 23% African American students 5 to 8 years of age to be overweight (King et al., 2006). These statistics suggest that failure to prevent risk factors for overweight development in young children in rural Appalachia will further exacerbate the increasing prevalence of obese adults and obesity related chronic diseases. Indeed, rural Appalachia appears to be a region where more research is needed to determine how to reduce risk of overweight development in children.

This study is the first reported primary prevention study in rural Appalachia with a multi-component approach. A multi-component intervention includes exercise and
nutrition delivered in both a school and family setting, which is now considered the gold standard for prevention of overweight status in children (ADA, 2006). However, research incorporating a multi-component design has yielded conflicting results. Some multi-component studies reported a decrease in body fat among subjects (via skin folds, body fat percentage, or use of BMI) whereas others have not (see appendix F). A few multi-component studies reported a significant increase in nutritional knowledge, but these studies did not track actual food consumption before and after intervention (Caballero et al., 2003; Going et al., 2003; Hopper et al., 1992; Hopper et al., 1996). Because of inconsistent data among previous studies, this present study involved a multi-component design to support or refute the use of this recommended research approach.

Nutrition Component

A unique aspect of the present multi-component study was the use of a three-day food record to track nutrient and food group intake before and after intervention. Adequate vitamin and mineral intake in children is critical for adequate growth and development. Results generated from the pre- and post-intervention food records found the children to be deficient in fiber, vitamin E, and potassium. This is consistent with previous research which has shown deficiencies or risk of deficiencies for calcium, iron, zinc, potassium, magnesium, and vitamin E (Ganji et al., 2003; Nead et al., 2004; USDHH, 2005). Thus, these nutrients should be scrutinized for deficiencies in future studies of children residing in rural areas.

Adequate intake of specific nutrients correlates to the proper consumption of foods from each food group designated in MyPyramid (USDA, 2006). The magnitude of
inadequate consumption of specific nutrients is difficult to assess due to past research using parameters from the outdated food guide pyramid instead of the current MyPyramid (Ganji et al., 2003; Nead et al., 2004; USDHH, 2005; USDA, 2006). However, the present study is one of the first to provide insight into potential food groups at risk for deficiency using the new parameters set by MyPyramid established in January 2006. Results indicate that fruit and vegetables are below recommended levels for the age group examined. Insufficient intake of these food groups explains the inadequate intake of fiber, vitamin E, and potassium.

An important finding of this study was the significant impact nutrition education had on dietary intake. The results of this study found a significant positive relationship between having nutrition education and the intake of magnesium ($t(24) = -2.391, p = .025$). Mean intake of magnesium in the experimental group increased by nearly 30 mg after treatment. Nearly half of magnesium ingested is from fruits, vegetables, nuts, and whole grains (USDA, 2008). Refined foods contain minimum quantities of magnesium (USDA, 2008), which is a reason schools should focus on fresh fruits, vegetables, and whole grains for meal and snack selections as opposed to processed or vending machine food items. The nutrition education sessions encouraging intake of fruits, vegetables, and whole grain foods probably played a significant role in increasing intake of this mineral.

Despite a significant difference in magnesium intake between groups, mean intake of magnesium at baseline was sufficient in both groups based on the RDA value. The RDA for magnesium is 130 mg per day for girls and boys 4 to 8 years of age (National Academy of Science, 2008). In addition, control group baseline levels of
magnesium were nearly 20 mg higher than the treatment group. The higher baseline level in control subjects may have magnified the results of treatment in the experimental group.

The results of this study also found a significant positive relationship between having nutrition education and the intake of milk ($t(24) = -2.362, p = .027$). The experimental group’s milk intake increased from approximately 2 to 2.5 servings per day. MyPyramid recommends 7- to 8-year-old children consume at least 2 cups of dairy per day. At baseline, both the control and experimental groups met this recommended amount. Literature indicates high calorie and sugar-filled beverages are replacing milk consumption in children especially teenage children (Borrud et al., 1996; Harnack et al., 1999; Rajeshwari et al., 2005). The combination of substituting sweetened beverages such as soda or juice in place of milk has been correlated to weight gain (Berkey, Rockett, Field et al., 2004). Children in rural areas are at particular risk because schools located in these areas have a higher proportion of vending machines, and the vending machines offer more sugar filled snacks which children can select from (Parsad & Lewis, 2006). Since milk intake appears to be decreasing in boys and girls (Borrud et al., 1996; Bowman, 2002; Troiano et al., 2000), it is important to examine techniques that will prevent this downward trend. Nutrition education in the classroom was proven to be an effective method to increase milk consumption.

Despite milk consumption significantly increasing in the experimental group, there was no significant increase in calcium intake. Calcium intake increased in the experimental group by only 3 mg, but decreased in the control group by 161 mg.
Calcium intake might not have been affected by servings of milk intake, because it is found in an abundance of other foods such as cheese, dark green vegetables, fortified grain products, and fortified juices.

Upon analysis of results, the investigator did not find a significant relationship between having nutrition education and the other six nutrients, sugar, or food groups examined. However, other positive changes in food consumption patterns were found in the group that received nutrition education. Specifically, children in the intervention group increased consumption of fiber by 3% and potassium by 7%. One possible reason for the positive (though nonsignificant) outcomes in a short period of time was the use of multiple volunteers to aide in classroom activities (teacher-to-student ratio of 1:3). The abundance of volunteers in the classroom helped each student fill out his or her nutrition binder accurately and answered questions promptly. The volunteers also ensured that each child was fully engaged during the 60-minute lesson. Children appeared to enjoy individualized attention by the volunteers. These children also appeared to enjoy the wide variety of activities using multiple educational techniques including: hands on, writing, coloring, and visual methods of teaching.

There may be several reasons why nutrients or food groups were not all affected by the nutrition intervention. The sample size was small and may not be reflective of the effect nutrition education has on intake of 2nd-grade children. Another reason might be nutrition education for parents was limited. Parents had three in-person nutrition encounters and the rest of the nutritional information was sent to the home. The post intervention survey indicates that only half received all five information flyers, and one
parent did not receive any. The short duration of the study, transportation, finding appropriate times to meet everyone’s schedule, or lack of interest to attend might have contributed to the inadequate amount of time spent delivering education sessions to parents. Overall, the short duration of the study might have been a reason why nutrient intake was not affected by the intervention. A longer study would allow for more time in the classroom giving nutrition education and reinforcing concepts, more time delivering nutrition education to parents, and more time for dietary habits to change based on nutritional lessons. Results might also be influenced by other sample characteristics such as inaccurate or missing data from food records recorded at home, snow days, and children missing school due to illness.

Anthropometric Data Related to Exercise Component

This study did not find a significant correlation between having exercise and nutrition education sessions with anthropometrics (via BMI and percent body fat) after 16 weeks. There may be several reasons why body composition was not affected by the exercise and nutrition program. First, results were probably influenced by the short duration of the study. Second, due to a relatively small sample size, boys and girls were grouped together to examine BMI and percent body fat changes before and after treatment. Third, perhaps with a larger sample, body composition changes would be indicated by analyzing the differences between both sexes along with differences between control versus experimental groups. Fourth, even at the start of the study there were relatively few subjects in an undesirable BMI range (>85th percentile), yielding a small sample for assessing significant changes in body composition. Because this study
served as a primary prevention (before weight gain occurs) this finding was not unexpected. The significance of both exercise and nutrition education with young children, and the effect of education on body composition might not be apparent until these children are older.

One limitation to the exercise component was the fact exercise sessions were designated only during physical education classes. The exercise arm of the study did not assess the amount of time the children participated in sedentary behaviors after school. Excessive television viewing is another factor linked to overweight development in children (Francis et al., 2003; Stettler et al., 2004; Stroebele & de Castro, 2004; Van Den Bulck & Van Mierlo, 2004). Excessive amounts of time children spend viewing TV leads to decreased energy expenditure and increased exposure to commercials promoting consumption of non-nutritious food items (Francis et al., 2003; Stettler et al., 2004; Stroebele & de Castro, 2004; Van Den Bulck & Van Mierlo, 2004). A future study tracking the amount of time each child watches TV or plays video games outside of school might provide insight into the association between sedentary habits and body composition status or intake of specific nutrients. Parents should also be given home exercise instruction to extend healthy exercise behaviors beyond the classroom. This additional component might positively affect body composition in future studies.

Limitations in anthropometric data collection also could have impacted results. Children were weighed upon arrival and were encouraged to void bladder and wait before eating the evening meal; however, some children might have failed to follow these recommendations. Some of the children might have consumed food or beverage
immediately prior to being weighed or might have forgotten to void bladder during pre-
and post-testing. Whether or not a child had extra weight due to a full stomach or bladder
during data collection might have slightly affected weight status, thereby altering BMI.

Cultural Factors

Researchers attempted to be culturally sensitive by designing nutrition lessons and
handouts at an appropriate reading level; however, other cultural differences between
participants and researchers might have affected results of the nutrition education
program. Health education in the Appalachian region should be designed to treat families
as a unit for the purpose of intervening effectively against unhealthy behaviors (Denham,
Meyer, Toborg, & Mande, 2004). Although researchers developed parent nutrition
education sessions, the literature suggests that women in the Appalachian culture
predominantly take on the responsibility for the health of their families (Denham et al.,
2004; Denham, 1996). A woman’s role in prevention of health risks within the family
implies that nutrition education targeting Appalachian mothers could positively affect the
nutritional status of the entire family. Women in Appalachia are positioned in a family to
intervene against behaviors that promote risks for nutritional deficiency or obesity; these
women may benefit from information that provides knowledge about nutrition and builds
skills to increase their effectiveness within this role. Interventions which are designed to
prepare mothers to influence healthy behaviors in the family might lead to more
significant results regarding nutrient intake and decreased BMI and body fat percentage.
Conclusions and Recommendations

Thirty-five 2nd-grade students were examined before and after a 16-week exercise and nutrition intervention. This intervention study implemented a primary prevention method with a multi-component approach. Previous studies have been inconclusive, making it necessary to continue to explore this topic. This is the first study reported that focuses on primary prevention with a multi-component design in rural Appalachia, Ohio. Changes in anthropometric data (BMI and percent body fat) and the relationship of nutrition education and dietary behaviors were examined. Results of this study demonstrated that nutrition education increased the intake of magnesium and milk in children which are essential for growth and development. Factors that may have influenced the results were using a nonrandom sample and having a small sample size.

This study was considered a primary prevention effort involving an intervention before overweight development occurs in children. Whether nutrition education early in life prevents development of overweight status will not be determined until future follow-ups are employed. In the future, the research team should have the participants from this study complete another food record and obtain anthropometrics to determine the effect of this type of intervention.

More research is necessary to fully understand the effect of nutrition and exercise interventions on dietary behaviors and body composition in children. Future research using a larger sample will increase the statistical power and generalizability of results. A study encompassing more schools in a rural area will help researchers achieve sample characteristics that are distinctive of rural Appalachia, an area greatly affected by obesity.
and chronic disease. Having the same number of children return food records and complete body measurements from both experimental and control groups would be desirable. Results might have been more significant if this had been achieved. Researchers should also try to use other valid methods of assessing body composition in children, such as underwater weighing or plethysmography, which might produce more robust data.

Cultural sensitivity should be taken into account when conducting research in the rural Appalachian region. Future studies in similar environments should include grocery store lists tailored to selecting lower cost seasonal fruits and vegetables. Nutrition education to students and parents would parallel grocery store lists. Nutrition education involving the family should be geared towards the women in the family to increase the success of dietary interventions.

Being overweight or obese is a condition that affects many lives by increasing risk for chronic disease. As researchers continue to explore this topic, the many negative consequences become more apparent. Dietitians and other health care professionals need to educate the public about prevention of excess weight gain in children. Many people do not realize that primary prevention is the key to preventing overweight development in children. Parents and schools should come together to promote healthy eating behaviors and exercise to prevent increasing numbers of overweight children, thereby helping to reduce the obesity epidemic in adults. It is our responsibility as nutrition professionals to help them do this.
Limitations

1. A 16-week intervention might not be long enough to produce significant change.
2. A convenience sample was used instead of a random sample.
3. Decreased parental participation and compliance due to schedule, economic constraints, and low education levels.
4. Compliance and accuracy in estimating children’s food consumption at home was limited.
5. Unplanned absences due to weather and illness might have adversely affect attendance.
REFERENCES


APPENDIX B: MAP OF APPALACHIA

The Appalachian Region

APPENDIX D: COUNTY ECONOMIC STATUS IN APPALACHIA

County Economic Status in Appalachia, FY 2007

APPENDIX E-1: HEART DISEASE MORTALITY FOR WHITE FEMALES

Death rates of each HSA compared with U.S. rate

Heart disease
White female

SOURCE: CDC/NCHS

Age-adjusted rate per 100,000 population

Significantly higher
80 highest *
Other high
Not significant
Significantly lower
Other low
80 lowest *

U.S. rate = 104.8

* See text

APPENDIX E-2: HEART DISEASE MORTALITY FOR WHITE MALES

APPENDIX E-3: HEART DISEASE MORTALITY FOR BLACK FEMALES

Death rates of each HSA compared with U.S. rate

Heart disease Black female

Age-adjusted rate per 100,000 population

- Significantly higher
- 80 highest *
- Other high
- Not significant
- Significantly lower
- Other low
- 80 lowest *

U.S. rate = 171.7

-source: CDC/NCHS

APPENDIX E-4: HEART DISEASE MORTALITY FOR BLACK MALES

Vegetable Group

Lesson 1. Eat all the colors of the rainbow!
PARTS OF A PLANT

- Flower
- Seeds
- Leaf
- Stem
- Stalk
- Roots

Diagram:

- Broccoli:
- Cauliflower:
- Peas:
Seeing in the Dark

Is it easy for you to see in the dark?

What is something you need to see in the dark?

Do you have a night light in your bedroom?
### Rabbit Food Salad

**Hop around while making!**

<table>
<thead>
<tr>
<th>Step</th>
<th>Instructions</th>
<th>Ingredients/Actions</th>
</tr>
</thead>
</table>
| 1.   | Make Pink Island Salad dressing: whisk in small bowl. | - ¼ cup grape jelly  
- ¼ cup vinegar  
- ½ cup olive or canola oil  
- 1 tsp. mustard |
| 2.   | Wash off lettuce and spinach leaves.               |                                                          |
| 3.   | Tear lettuce into bite-size pieces and place in bowl. |                                                          |
| 4.   | Add                                                 | - Tomatoes  
- Celery  
- Carrots  
- Peas  
- Cranberries  
- Sunflower seeds  
- Peppers  
- Radishes  
- Cauliflower  
- White beans |
| 5.   | Toss with salad dressing                           |                                                          |

Name other foods you can put in a salad:

______________________,  ______________________

______________________,  ______________________

How many dark green vegetables should you eat each week?

____________________

How many orange vegetables should you eat each week? Name an orange vegetable.

______________________,  ______________________
Learning Assessment

I know that _______________ and _______________ are in the vegetable food group.

Vegetables I like to eat are:___________________, ___________________, ___________________, ____________________

I ate _______________ vegetable yesterday.

True or False- color the circle green for true and red for false.

Lunch is a great time to eat or try a vegetable

Vitamin A improves night vision.

Vitamin C prevents colds.

Broccoli contains vitamin C.

I ate salad greens at home this week

I should eat different colors of vegetables

Calcium can be found in vegetables.

I want to try and taste new vegetables

Cranberries are a vegetable.
Fruit Group

Lesson 2. Eat a variety of fruit every day.
How can I add fruit to my day?

At: ___________________________

During: _______________________

When else at school? ___________

How else can I add fruit to my breakfast (Hints: see pictures below)?

______________________________

______________________________

Try a fruit with dinner or for an evening snack. Below write your favorite fruits to eat at home.

______________________________

______________________________

______________________________
Friendship Fruit Parfait

1. Gather ingredients
   □ frozen or fresh pineapple
   □ ripe banana
   □ frozen strawberries
   □ 4 oz. low fat vanilla yogurt
   □ Grape Nuts Cereal™ (or generic version)
   □ dried fruit (optional)

2. Cut banana into bite-size pieces. Set aside in a bowl.

3. Drain frozen fruit and add to bananas

4. In small bowl:
   • sprinkle bottom with a spoonful of cereal
   • add a few pieces of fruit
   • add yogurt
   • top with a spoonful of both cereal and fruit.

5. Enjoy with your friends.

Name other foods you can put in a yogurt parfait:
___________________, ___________________
___________________, ___________________

How many times should you eat fruit each day?
Name a red fruit: ______________
Name a white fruit: ______________
When during the day can you eat fruit?
Go For Whole Grain

Lesson 3. Aim for 3 servings of whole grains a day!
What are examples of whole grain foods?
Circle choices of whole grains.

- whole grain oat cereal
- 100% whole wheat bread
- toasted white bread
- brown rice
- rye bread
- white rice
- fruity cereal
- whole wheat pasta noodles
- rolled oats cereal
# Tango Twist Pretzel

1. Thaw loaf of whole wheat bread dough. Slice loaf into 10 even cross-sections.

2. Roll each dough section between your hands allowing it to slowly stretch into a rope.

3. Once dough is long enough, gently twist into a pretzel shape.

4. Whisk 1 egg in a small bowl. Brush pretzel with ~1 tsp of the whisked egg and then sprinkle with one of the following:
   - [ ] sesame seeds
   - [ ] rolled oats

   Place pretzel on baking sheet which has been sprayed with vegetable oil cooking spray.

5. Let pretzel rise for 1-2 hours. Bake pretzels in preheated 325°F oven for 15 minutes or until pretzel is golden brown.

**ENJOY THE TASTY TANGO TWIST PRETZEL**

Name other whole grain foods

__________________________, ____________________________

How many pieces of whole grain bread and cereal foods should you eat each day?

__________________________
Lesson 4. Go low sugar when quenching your thirst!
Drinking low sugar beverages is good for teeth, skin, and weight.

Circle the best answer from the words in the ()

1. With my after school snack, it is healthy to drink (water/ pop).

2. Drinking (Kool Aid/ Crystal Light) with my after school snack, is healthy for my teeth.

3. Along with exercise, drinking (milk/ Hawaiian Punch) at dinner will help keep my body at a healthy weight.

4. Drinking (sweet tea/ 100% apple juice) at breakfast on Saturday will count as a serving of fruit.

5. (Snapple/ cold water) will be the best choice to prevent me from getting thirsty or dehydrated.

A beverage I can drink anytime during the day is: ____________________________

I should replace ________________________ with water.

Image 1 from: http://www.geocities.com/don_homer.rm/Renteeth.jpg

Image 2 from: http://www.chaletsmile.com/images/smile.jpg
Healthy Protein

Lesson 5. A growing body needs protein!
### Protein Packed Tuna Rolls

<table>
<thead>
<tr>
<th>Step</th>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Chop celery and set aside in small bowl.</td>
</tr>
</tbody>
</table>
  |   - 2 tbsp. light tuna  
  |   - 1 tbsp. drained mandarin oranges  
  |   - ½ tbsp. reduced fat mayo  
  |   - chopped celery  
| 3.   | Mix well with a fork. |
| 4.   | Spread tuna mixture onto a ½ whole wheat tortilla. Top with shredded romaine lettuce. |
| 5.   | Don’t forget to roll it up! Feel this protein pack roll build a healthy body. |

Name the food groups that are included in this recipe:

___________________,____________________  
___________________,____________________

Dairy is missing from this recipe, what can you add to include a food from the dairy group?

__________________________________

Name two foods that are good sources of protein?

_______________________________, ________________________________
Building a Healthy Meal

Lesson 6. Pick foods from each food group to make a complete meal.
# Rainbow Pizza

**Build a Complete Meal!**

1. Thaw loaf of whole wheat bread dough. Slice loaf into 8 even cross-sections.

2. Roll each piece of dough into a small ball shape. Next, flatten dough ball on wax paper. Use the drawn circle as a guide for shaping your pizza crust. Set aside, and let rise.

3. Slice spinach into shreds and chop mushrooms. Pull apart broccoli into small pieces. At home, add your favorite veggies!

4. Spread 1 spoonful of pizza sauce onto dough. Leave ½ inch for the crust. On sauce, sprinkle, spinach, mushrooms, carrots, and broccoli.

5. Top veggies with 1 spoonful of shredded cheese. On top of cheese, sprinkle with chopped pepperoni. Bake at 350° for 10 minutes.

**Name the food groups that are included in this recipe:**

___________________,____________________
___________________,____________________

**Fruit is missing from this recipe, what can you add to include a food from the fruit group?**

**Name two nutrients found in this recipe?**

__________________, ________________
APPENDIX G: CHARACTERISTICS OF MULTI-COMPONENT ELEMENTARY SCHOOL-BASED OVERWEIGHT PRIMARY PREVENTION INTERVENTIONS

<table>
<thead>
<tr>
<th>Intervention Description (Name)</th>
<th>No. Students/ No. Schools</th>
<th>Age/Grade at Baseline</th>
<th>Duration (1 yr = 1 school year)</th>
<th>Measure of Adiposity</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Randomized Controlled Trials</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>APPLES\textsuperscript{a}</td>
<td>595/10</td>
<td>7-11 yr</td>
<td>1 yr</td>
<td>BMI</td>
<td>NS</td>
</tr>
<tr>
<td>CATCH\textsuperscript{b}</td>
<td>4019/96</td>
<td>3\textsuperscript{rd} grade</td>
<td>3 yr</td>
<td>BMI, TSF, SubSF</td>
<td>NS</td>
</tr>
<tr>
<td>CATCH\textsuperscript{c}</td>
<td>4019/96</td>
<td>3\textsuperscript{rd} grade</td>
<td>3 yr</td>
<td>BMI, TSF, SubSF</td>
<td>↑ BMI in AA; NS for other msmts/groups</td>
</tr>
<tr>
<td>CATCH\textsuperscript{d}</td>
<td>4019/96</td>
<td>3\textsuperscript{rd} grade</td>
<td>3 yr/f/u</td>
<td>BMI, TSF SubSF</td>
<td>NS</td>
</tr>
<tr>
<td>Pathways\textsuperscript{e}</td>
<td>1409/41</td>
<td>2\textsuperscript{nd} grade</td>
<td>3 yr</td>
<td>BMI, TSF SubSF, %BF</td>
<td>NS</td>
</tr>
<tr>
<td>KYB\textsuperscript{f}</td>
<td>1,115/22</td>
<td>4\textsuperscript{th} grade</td>
<td>1 yr</td>
<td>PI, TSF</td>
<td>NS</td>
</tr>
<tr>
<td>KYB\textsuperscript{g}</td>
<td>1,769/37</td>
<td>4\textsuperscript{th} grade</td>
<td>5 &amp; 6 yr</td>
<td>PI</td>
<td>NS</td>
</tr>
<tr>
<td>KYB\textsuperscript{h}</td>
<td>431/9</td>
<td>4\textsuperscript{th} – 6\textsuperscript{th} grade</td>
<td>2 yr</td>
<td>PI, TSF</td>
<td>NS</td>
</tr>
<tr>
<td>KYB\textsuperscript{i}</td>
<td>216/9</td>
<td>4\textsuperscript{th} – 6\textsuperscript{th} grade</td>
<td>4 yr</td>
<td>PI, TSF</td>
<td>NS</td>
</tr>
<tr>
<td>6 different Programs\textsuperscript{j} (5 plus a C)</td>
<td>869/30</td>
<td>10-12 yr</td>
<td>1 yr</td>
<td>BMI, TSF SubSF, %BF</td>
<td>↓ TSF; NS for other msmts</td>
</tr>
<tr>
<td>Study Design</td>
<td>Age Range</td>
<td>Time Period</td>
<td>Measurements</td>
<td>Changes</td>
<td></td>
</tr>
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<td>-------------------</td>
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<td></td>
</tr>
<tr>
<td>KOPS k</td>
<td>5-7 yr</td>
<td>1 yr</td>
<td>BMI, %BF (OW only), TSF</td>
<td>↓ TSF, ↓ %BF (OW)</td>
<td></td>
</tr>
<tr>
<td>Prudent Dietl</td>
<td>6-7 yr</td>
<td>5 yr</td>
<td>BMI</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>KYB m</td>
<td>1st – 6th grade</td>
<td>3 yr</td>
<td>BMI</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>KYB n</td>
<td>1st grade</td>
<td>3 yr</td>
<td>BMI, SupraSF</td>
<td>↓ BMI, ↓ supraSF</td>
<td></td>
</tr>
<tr>
<td>KYB o</td>
<td>1st grade</td>
<td>3 yr</td>
<td>BMI, supraSF</td>
<td>↓ BMI, ↓ supraSF</td>
<td></td>
</tr>
<tr>
<td>AHA /</td>
<td>3rd grade</td>
<td>1 yr</td>
<td>%BF</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Heart Power p</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bienstarq</td>
<td>4th grade</td>
<td>1 yr</td>
<td>BMI, %BF</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>3 treatments:</td>
<td>5th and 6th grade</td>
<td>6 wk</td>
<td>%BF</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>H/S, SO, Cr</td>
<td>32/2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 treatments:</td>
<td>5th and 6th grade</td>
<td>6 wks</td>
<td>SSF</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>H/S, SO, C^5</td>
<td>132/N/S</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 treatments:</td>
<td>4th grade</td>
<td>10 weeks</td>
<td>SSF</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>H/S and C^5</td>
<td>97/N/S</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Abbreviations: ↓ = decreased; ↑ = increased; %BF = percent body fat; AA = African Americans; AHA = American Heart Association; APPLES = Active Program Promoting Lifestyle in Schools; BMI = body mass index; C = control; CATCH = Child and Adolescent Trial for Cardiovascular Health; H/S= home and school; KOPS = Kiel Obesity Prevention Study; KYB = Know your body; Msmts = measurements; N/S = not specified; NS, not significant; OW = overweight; PI = ponderosity index; SO = school only; SSF = sum of skinfolds; SubSF = subscapular skinfold; TSF = triceps skinfold; wk = weeks; yr = year. From “Final Appendices for Position of The American Dietetic Association: Individual-, Family-, School, and Community-Based Interventions for
APPENDIX H: IRB APPROVAL FORM

The following research study has been approved by the Institutional Review Board at Ohio University for the period listed below.

Project: The Effects of Exercise and Nutrition Interventions on Obesity Development and Pre-Diabetic Predisposition of Elementary School Children

Researcher(s): Frederick C. Hagerman
Majorie T. Hagerman
Roger M. Gilders
Karen Montgomery Reagan

Advisor: (if applicable)

Department: Biomedical Sciences

Jacqueline Legg, M.B.A., Chair
Institutional Review Board

Approval Date 12/11/07
Expiration Date 12/11/07

This approval is valid until expiration date listed above. If you wish to continue beyond expiration date, you must submit a periodic review application and obtain approval prior to continuation.

The approval remains in effect provided the study is conducted exactly as described in your application for review. Any additions or modifications to the project must be approved by the IRB (as an amendment) prior to implementation.

Adverse events must be reported to the IRB promptly, within 5 working days of the occurrence.
APPENDIX I: PARENTAL CONSENT FORM

Informed Consent

Title of Research: School based exercise-nutrition intervention: effects on healthy measures in rural children

Principal Investigator: Fredrick C. Hagerman, Ph.D
Co-Investigator: Marjorie T. Hagerman, M.S.
Roger M. Gilders, Ph.D.
Karen Montgomery-Reagan, D.O.

Department: Department of Biomedical Sciences
School of Human and Consumer Services
School of Recreation and Sport Sciences
Ohio University College of Osteopathic Medicine

Federal and university regulations require obtaining your parental signature consent before your child participates as a subject in this research study. After reading the description of the proposed study and the specific tasks required of your child and you throughout the study, please indicate your consent or approval of your child’s participation in the study and your support of the study’s goals by signing this document.

Statement of research

It is a principle of a scientific investigation that a subject who is to participate in a research study be required to give his or her informed consent to such participation. Because the subjects for this study are not eligible to legally give their consent to participate, you, as a parent/guardian will be required to provide, in their stead, your informed consent in order for the minor child to participate as a subject. This document provides information of the nature and possible risks and benefits of the study and with the help of a verbal explanation, the study’s goals, objectives, and procedures will become more clear. If you have any questions, please ask.
Explanation of Study

Purpose of the research

Your child is being asked to serve as a subject in a study that will attempt to determine the effects of an exercise training and nutrition intervention program on several physiological measurements and on behavioral responses to nutritional recommendations and changes.

Procedures to be followed

Participation by students as subjects for this study will be strictly on a voluntary bases. If your child becomes a participant in this study he/she will be medically examined by one of the co-investigators, Dr. Montgomery-Reagan, a certified pediatrician and you will be required to complete a health history form for your child before medical examination is conducted. Parents/guardians will be required to be present at medical examinations and these exams will take place at the schools. If you consent to your child’s participation as a subject in this study then he/she must be healthy enough to safely tolerate exercise testing and possible exercise training. If he/she is shown to be at risk due to problems revealed on the health history form or problems discovered during the medical examination, participation as a subject in the study will not be permitted. All results of medical examination will be explained to each parent/guardian. If your child is shown to be at no risk to exercise intervention and has no signs or symptoms of food intolerances then each will be eligible to complete the initial testing program. This testing program will be repeated again after 16-weeks of exercise training and dietary intervention for the experimental group of subjects while the control subjects will be required to carry on with their normal life styles for 16-weeks with the expectation that no significant changes will be made in their exercise or dietary habits during this period.

Students who volunteer as subjects from Amesville elementary will be assigned to the experimental group and will begin exercise training for 16 weeks following the initial 2-week testing period. Student volunteers from Coolville elementary will be asked to serve as control group subjects and to conduct themselves as described earlier in this section. Group assignments were determined by random selection with approval by each school’s principal.

Before testing begins a parent/guardian and student information meeting will be conducted by the investigators at each participating school in order to thoroughly explain the specific roles of subjects assigned to each research group and so that adults and children can become familiar with testing equipment and procedure.
Explanations of all exercise and dietary tests will be provided at this time and any questions answered.

After becoming familiar with the exercise testing equipment and procedures, including the use of the rowing ergometer (indoor rowing machine) and the test procedures, the following tests will be conducted with all subjects on site at each of the participating schools and each parent/guardian will be encouraged to be present for all tests.

- Body composition
- Blood lipid and glucose profiles
- Aerobic fitness testing
- Diet assessment

Before conducting this test each subject will have the opportunity to try using the breathing equipment and although it may seem strange to breathe through a mouthpiece or mask this equipment should not interfere with breathing even during exercise. We have conducted thousands of these same tests, including elementary school children, and have never experienced any breathing problems in any of many studies we have carried out in over 40 years of similar research. A complete familiarization with the rowing ergometer exercise will be afforded each subject before actual testing begins. The rowing exercise (technique) can be learned quickly and no problems related to performing this exercise are anticipated. Each subject will be fitted with a breathing valve and nose-clip or breathing mask connected to a computerized analyzer that will measure breathing responses. Also, each subject will be required to wear a heart rate monitor on an elastic band around their chest and back so that heart function can be recorded by wireless technique to a recorder. In this way heart function can be observed continuously during the pre-exercise rest period and during the brief exercise-test session. Blood pressure will be measured with small button sensors placed on the skin above the crease of the elbow. None of these breathing and heart measurements will involve invasive techniques and are painless and will cause no unusual discomfort. Measurements like these have been made possible by techniques developed over many years of research by NASA’s manned space program, including technical contributions by our laboratory.

Following approximately 5 minutes of recording breathing and heart functions at a sitting-rest position on the rowing ergometer each subject will be required to begin the rowing exercise by starting to produce a very low power output which will be maintained for the first minute of exercise. Following the first minute of exercise, each subject will be required to minimally raise power output by approximately 5-10 watts above the starting power output of 10-20 watts (minute one). The subject will then be asked to continue to raise power output by 5-10 watts every minute thereafter until the conclusion of the exercise test. These work loads are very minimal and your child should have no problems sustaining them.
It is anticipated that this test should be concluded in 3-8 minutes. This exercise test will be stopped at any time if the subject decides that it would be difficult to continue, target exercise values, as observed by the investigators, have been reached, or the subject begins to show signs of fatigue or stress. You may be assured that after 40 years of conducting these tests our laboratory has not observed any unusual physical problems associated with these tests that may affect the health and well-being of the subject.

Experimental subjects will be represented by student volunteers from 3 second grade classes at Amesville elementary school and the control subjects will be students volunteers from 2 second grade classes at Coolville elementary school. Although both groups of subjects will be required to submit to all tests described earlier in this document, a pre-test and then 16 weeks later a repeat of the same tests (post-testing) conducted earlier, only the experimental group subjects will participate in the 16-week exercise training program. The control group subjects are required to carry on with their current lifestyles neither adding to- or subtracting from- their normal exercise, dietary, sleep, social, etc. habits for the 16-week period. Volunteers assigned to the experimental group will begin rowing ergometer exercise training after all pre-training testing has been completed. Rowing training will begin with 2-3 brief intermittent bouts of exercise lasting 2-3 minutes with similar time periods for rest between these short exercise bouts. Exercise intensity will be regulated by using exercise heart rate monitored by special wireless sensors attached to the chest and the heart responses are then sent by wireless electrical signals to special monitors.

Experimental group subjects will be required to participate in a 16-week rowing ergometer training program meeting two days per week (32 training sessions) for 10-15 minutes exercise sessions. Each experimental or exercise training subject will be permitted to miss only 3 training sessions in order for test responses to be applied to the results of the study. In the case of illness, any personal problems, or if classes are canceled for any reason, make-up training sessions will be offered.

Initially an exercise intensity of between 55-70% of maximal heart rate will be used as a general guideline and this range of intensity is equal to the energy expenditure of moderate play activity for this age group. As training progresses and the children adapt to the exercise training they should be able to gradually elevate their training intensity levels to between 75-80 % of maximal heart rate which is still an intensity well below high energy play energy expenditure for them. It is hoped that this exercise intensity can be achieved by the conclusion of the 16-week training period. Exercise training duration will be gradually increased to 5-8 minutes for a few intermittent bouts of work with every-decreasing recovery periods. Most of the subjects should be able to sustain a
single moderate intensity steady-state exercise bout on the rowing ergometer for a period of 10-12 minutes by the conclusion of the 16-week training.

Subjects should dress in shorts, T-shirt, and gym shoes for all exercise-related tests.

Body composition and age, height, weight will be measured and percent body fat using skinfold calipers to measure three surface or skin folds; on the back of the arm, at the belly-button, and in front of the thigh; this is a fast, non-invasive, painless technique.

A very small (single drop) 25 microliter blood sample will be taken from the finger by an experienced investigator. Although this is minimally invasive technique, the development of microliter blood sampling has eliminated most or all pain responses and the likelihood of any subject experiencing discomfort is very low. Thousands of these tests have been performed in our laboratory without incident. As an incentive and an attempt to make your child feel more at ease, each parent/guardian is encouraged to also submit to this test as the child observes. Results of this testing will not only provide the investigators with valuable lipid and glucose profile data but adults can also learn of the current status of their blood lipids and glucose and explanations of the results will be provided by investigators. Analysis of the blood sample will reveal:

- Total cholesterol
- High density lipoprotein cholesterol
- Total cholesterol : High density lipoprotein cholesterol ratio
- Low density lipoprotein cholesterol
- Two hour post-prandial (after eating a meal or snack) blood glucose level

Nutrition assessment is the process of describing your child’s usual food intake over a time period of a day or week, and then relating that information to current health recommendations for children of the same age. At the beginning of this study and 16 weeks later at the conclusion, you will be asked to describe for the investigators how often your child eats specific foods – the number of times each day he/she drinks milk for example, or for foods not consumed every day, like fish or pizza, how many times he/she usually eats them over a week. We will provide any assistance you request in filling out a form for you to indicate how often your child eats these foods (hence the name of the form, Food Frequency), and then will discuss with you the size of the helping your child usually eats of the various foods and beverages.

In the 16 week period between completing the two Food Frequency forms, your child will participate in some new ways to think about food and health during short classroom food experiences. In a 15-20 minute session, all children in your youngster’s class will prepare a simple food item (for example, a veggie pizza on
a whole wheat bread dough crust), learning to name the various ingredients used, and how they can help keep him/her healthy. In the case of this pizza, your child will learn the importance of eating healthy green foods like spinach, healthy red foods like tomatoes and examples of other whole grain cereal and bread products and why he/she should choose to “go with the whole grain”.

While your youngster is expanding his/her food choices through four or more in-class food experiences as described above, investigators will plan three or more sessions for one or both parents/guardians to attend. The good experiences for parents/guardians will address how to plan healthy meals for the family, how to encourage your second grader to help in food preparation at home and how to understand and work with problem eaters. Parents attending these sessions will have an opportunity to taste some new menu inclusions and will receive a book on child feeding, which will serve as a resource for discussing together how to make family mealtimes both healthy and enjoyable for the whole family.

Duration of subject's participation

20 weeks

Identification of specific procedures that are experimental

N/A

Risks and Discomforts

The investigators anticipate no unusual risks or hazards due to test equipment or procedures. There is the possibility of acute fatigue during exercise and the possibility of localized muscle and joint soreness following exercise. These problems will be minimized or eliminated by experienced investigators closely and continuously observing subjects and monitoring real-time physiological responses. Although subjects will be breathing through a mask or breathing valve, we have not encountered any breathing problems during rest, exercise, or recovery during 40 years of conducting these same tests with thousands of adults and children. If any physical problems occur, all testing personnel are trained and certified in CPR. Mobile and direct telephone service will be immediately accessible and emergency telephone numbers posted in clear view of testing staff. Subjects will be instructed before the exercise test that if they can no longer continue to exercise without feeling severe fatigue or are experiencing difficulty in breathing, they may stop exercising at any time.

Because the training sessions will all be conducted at a submaximal training intensity and carefully monitored and regulated by heart rate, we do not anticipate any unusual problems, responses, or complications. The subjects will only be
training twice weekly with at least 24 hours between training sessions and these training sessions will only be of 5-15 minutes duration. Safety precautions will be stressed and emergency procedures described previously for exercise testing will be observed. Subjects will be exercising without special breathing apparatus during training thus exercising in a normal manner.

Because of the invasive nature of blood withdrawal there is a slight risk of infection, bruising, and minimal bleeding from finger tip but the likelihood of any of these events occurring is very rare. The use of an experienced investigator at taking a small finger-tip blood sample (only a drop), a relatively painless technique, and using sterile procedures will eliminate any risks. We will suggest to parents and/or guardians that, although not mandatory, that they consent to offer a finger prick sample to also be analyzed, along with their child’s blood sample, for blood lipids and glucose.

The sole nutritional risk to subjects enrolled in this study is deemed to be possible food intolerances which one or more of the young subjects may develop or have exacerbated through possible changes in the school foodservice menus, or through food preparation/tasting experiences in the classroom. To avoid any adverse physiological effects from specific foods, investigators will review carefully the pediatric medical history form completed by a parent of each potential subject. One section of this form asks for a history of the child’s allergies, a second section requests a list of current allergies which the child presents. Of particular note would be peanuts, tree nuts, milk, eggs, chocolate, fish or shellfish, selected fruits (e.g. strawberries) and grain-based items containing gluten protein. All of these foods have the potential to cause an adverse reaction in susceptible individuals.

Philosophically, we may have youngsters who are strict vegetarians (vegans), or who avoid certain foods due to religious convictions and practices, or who have strong cultural biases toward selected food items.

We will either simply avoid using a particular food item found to be poorly tolerated by several subjects, or be certain there is an alternate food of similar nutritional value for the affected child to substitute. In no case will any youngster be encouraged or expected to eat any food which she/he historically has not well tolerated either physiologically or philosophically.

Although no injuries are anticipated during any part of the study, if your child is physically injured during participation in the testing or training phase of this study, there is no arrangement to provide reimbursement for medical care or other compensation.
Benefits

Subjects and parents will be advised of current physical fitness and nutritional status by specific fitness and dietary comparative observations and be informed of the results of the two study groups.

The investigators are planning classroom food experiences to help second grade youngsters learn how a wide variety of colorful, tasty foods can help them grow and stay energized and healthy to develop to their full potential. We hope that by learning about what and how much to eat, your second-grader will begin a lifelong positive attitude toward food and mealtime.

We also hope that by exploring a parent’s/guardian’s role in child feeding, you will feel comfortable doing your job with respect to feeding, and allow your child to do their job with respect to eating.

It is hoped that both children and parents will learn and appreciate the importance of a physically active lifestyle as well as the healthy food resources and choices to not only provide energy to support increased movement but to also burn excess calories. It is also hoped that you and your child will achieve, by your participation in this study, current knowledge and information relating to obesity and overweight so that everyone will be more aware of the symptoms, prevention, and treatment of these problems. Although this study represents a pilot or initial trial study, expectations are that the possible positive outcomes of the study will confirm the need to emphasize more physical activity and a healthy diet to insure immediate and long-term influences on subjects and parents. If successful, this small pilot intervention program may be expanded to other schools in the district. Furthermore, it could be an important small step in securing a more healthy future for you and your child.

Alternative Treatments (if applicable)

If a parent and/or child decides that they would prefer not to supply a blood sample and yet are willing to submit to all other testing requirements of this study, it is the decision of the investigators to permit the child to continue participating as a subject.

Confidentiality and Records

All written health history questionnaire and medical examination data will be stored in a locked file in a locked records room. Parents/guardians may request copies of these documents for their child at any time if their request is based on the need to provide medical information to a physician, clinic, or hospital. The
request must be in writing, including the name, place, and affiliation of the physician requesting this information. All child volunteers will receive a subject number and only the co-investigators will be able to identify the specific subject by number designation. A numbered code key will be developed to match the name of the subject with a respective subject number. This key will also be secured in a locked file in the same locked records room mentioned previously. Only one co-investigator and graduate student assistant have access to the records room and only one co-investigator has keys for the file within.

All research data gathered during the course of the study will also be filed and secured in the records room. In addition, all hard copy data will be transferred to disks for computer storage and these disks will also be stored and locked in our records room. All research data will be compiled and only group data will be used for statistical analysis and for dissemination and publication. All data will be shared with parents/guardians and explanations of the results of the study will be conveyed at a meeting with parents/guardians following completion of the 20-week study.

Research information without specific identification of your child may be used and disclosed indefinitely, but you may stop these uses and disclosures at any time in a written request to any of the co-investigators.

Compensation

There is no monetary compensation for participating in this study. Your child is free to withdraw from the study at any time without any penalties or without affecting his/her relationships with anyone associated with the administration and conduction of the study.

Contact Information

If you have any questions regarding this study, please contact

Fredrick C. Hagerman, Ph.D.

hagermaf@ohio.edu

740-593-2291

If you have any questions regarding your rights as a research participant, please contact Jo Ellen Sherow, Director of Research Compliance, Ohio University, (740)593-0664.

I certify that I have read and understand this consent form and agree to give my consent to my minor child to participate as a research subject in the study described. I agree that known risks to my child have been explained to my satisfaction and I understand that no compensation is available from Ohio University and its employees for any injury,
resulting from my child’s participation in this study. I certify that I am 18 years of age or older. My consent for my child’s participation as a subject in this study is given voluntarily. I understand that my child may discontinue participation at any time without penalty or loss of any benefits to which he/she may otherwise be entitled. I certify that I have been given a copy of this consent form to take with me.

Signature of consenting parent/guardian

_________________________________________________________________________ Date __________

Printed Name________________________________________________________________

After listening to an explanation of this study by one of the doctors from Ohio University and talking to my parents about what I would be doing in the study I agree, with my parents consent, to serve as a research subject.

Signature of assenting child

_________________________________________________________________________ Date __________

Printed Name________________________________________________________________
APPENDIX J: MEDICAL HISTORY FORM

Healthy Lifestyles Through Nutrition and Exercise
Preparticipation Physical Evaluation

Name ____________________________ Sex ______ Age ______ Date of Birth ______

School ____________________________ Address ____________________________

Personal Physician ____________________________ Phone ____________________________

In case of emergency, contact: Name ____________________________ Relationship ______

Phone (H) ____________________________ (W) ____________________________

History:
This section must be carefully completed by the student’s his/her parent(s) or legal guardian(s) before participation in order to help detect possible risks.

1. Has a doctor ever denied or restricted your participation in sports/exercise/playful activities for any reason? YES NO
2. Do you have an ongoing medical condition (like diabetes or asthma)? YES NO
3. Are you currently taking any prescription or nonprescription (over the counter) medicines or pills? YES NO
4. Do you have allergies to medicines, foods, or stinging insects? YES NO
5. Do you think you are in good health? YES NO
6. Have you ever passed out or nearly passed out DURING exercise? YES NO
7. Have you ever passed out or nearly passed out AFTER exercise? YES NO
8. Has a doctor ever ordered a test for your heart? (EKG for example) YES NO
9. Has anyone in your family died for no apparent reason? YES NO
10. Does anyone in your family have a heart problem? YES NO
11. Has any family member or relative died of heart problems or of sudden death before age 50? YES NO
12. Does anyone in your family have Marfan syndrome? YES NO
13. Have you ever spent the night in the hospital? YES NO
14. Have you ever had surgery? YES NO
15. Have you ever had an injury that caused you to miss exercise or playful activities? YES NO
16. Have you ever had a broken or fractured bone or dislocated joint? YES NO
17. Do you regularly use a brace or assistive device? YES NO
18. Has a doctor every told you that you have asthma or allergies? YES NO
19. Do you cough, wheeze, or have difficulty breathing during or after exercise? YES NO
20. Is there anyone in your family who has asthma? YES NO
21. Do you have any skin problems? YES NO
22. Have you been sick the last month? YES NO
23. Have you ever had a head injury? YES NO
24. Do you have headaches with exercise? YES NO
25. Have you ever had a seizure? YES NO
26. Do you have any problems with your eyes? YES NO
27. Do you wear glasses? YES NO
28. Do you have any concerns that you would like to discuss with a doctor? YES NO

Explain “Yes” answers here: (attach additional sheets as needed)

I (we) hereby state, to the best of my (our) knowledge, any (our) answers to the above questions are complete and correct.

Signature: ____________________________ Date: ____________________________

Parent or Guardian

Modified from American Academy of Family Physicians, American Academy of Pediatrics, American College of Sports Medicine, and American Osteopathic Academy of Sports Medicine
APPENDIX K: PRE-TESTING PICTORIAL FLOW CHART

Federal Hocking Healthy Lifestyle Program: Guide For Parents.

**Step 1.**
- Information Meeting
- Sign Consent
- Medical History
- Bring back for pre-testing
- Pick after-school day and time slot for testing:
  Date/Time picked: __________

**Step 2.**
Come to school on day and time picked at step 1.
Attend each of the three stations.

- Doctor's Exam
- Exercise Test
- How to record foods your child eats.
  - Allow 45 minutes total for the 3 stations, then enjoy
  - Pizza Party
  - T-shirt for Child
  - Kroger Gift Card

**Food Record Practice**
- At the March testing session: Use a special form we give you to practice writing your child’s food intake.
- On 3 assigned dates: record all foods your child eats away from school. When complete, return form in stamped envelope.

**Doctor’s Exam**
- Return medical history form given at step 1. by __
- At march testing session, your child will be looked at by a doctor. The key part of this exam will be the history form you filled out earlier and brought back.
- The doctor will look at details from the physical exam and history form. Then the doctor will decide if it is safe for your child to join in the project.

**Exercise Test: what to expect**
- Age, height, weight and other measurements will be gathered.
- Breathing mask will be fitted.
- Heart rate belt will be fitted.
- Child will practice with rowing machine- warm-up.
- Exercise test on rowing machine.
APPENDIX L: SCHOOL FOOD RECORDING FORM

Note. “School Food Recording Form.” Individuals recording food intake circled food items selected by the second grade student. Lunch food items on form would change to reflect what was being served in the lunch room on the assigned date. Extra spaces were provided to additional food items.
APPENDIX M: FOOD TRACKING INSTRUCTIONAL GUIDE FOR PARENTS

Tracking Your Child’s Food Intake

1. Food record will be completed over three days. Two weekdays and one Saturday will be assigned.

2. Enter all food items and brand names if needed on the form provided as soon as possible after each meal or snack. Look at portion guides below to estimate portion sizes. If your child does not finish all food items on his/her plate, report only amount of food actually eaten.

3. If you need to estimate portions, here are some examples:
   - Cooked meat about 3 ounces = card deck
   - ½ cup of vegetables = computer mouse
   - Margarine or butter 1 teaspoon = tip of your pinky finger
   - Mayonnaise 1 Tablespoon = tip of your thumb

4. Enter the type of preparation, such as:
   - Grilled chicken breast
   - Steamed vegetables
   - Chicken breast and wing breaded and fried in 1 tablespoon vegetable oil
   - 1/2 baked sweet potato

5. Be sure to include all foods consumed – jelly on toast, nuts on ice cream, cheese on a salad, etc. Include the fat level of dairy products (2% or 1% milk, low-fat or regular cottage cheese, regular or nonfat yogurt), salad dressings, and meats (ground beef, ground chuck, ground round).

6. When available, attach the food label from a package of food.

7. If you eat fast food, write the name of the restaurant, the item your child ate and if it was small, medium, large, super-size, etc.

8. Remember to write down all drinks and be sure to say regular, diet or sweetened with sugar.

9. Don’t change the way your child is eating now. We need to know what your child’s eating habits are at the present time.

Questions or concerns contact:
Marge Hagerman, RD, LD  phone: 740-593-6367  email: hagerman@ohio.edu
Tara Harwood, RD, LD  phone: 740-591-2742  email: tara.harwood@yahoo.com
APPENDIX N: END OF STUDY INTERVIEW QUESTIONS FOR PARENTS OF EXPERIMENTAL SUBJECTS

1. There were 5 Nutrition Information Memos sent home with second graders for their parents. How many of these did you receive?

2. These memos related to food experiences your child had in his/her class. Which memos that you received did you read and find helpful?

3. Do you plan to use the information in any way in the future?

4. There were 6 different food experiences the children had in their classrooms, 5 of which involved preparation of a food item and then eating it. Did your child describe any of these “cooking” lessons and the nutritional principles taught along with the cooking?

5. If so, which ones?

6. Has your child tried making any of the foods at home that they made and tasted at school? Which ones?

7. Can you identify 2 or 3 points your child has learned and talked about at home as a result of the nutrition/cooking experience?

8. Any food practices your family has changed/adopted as a result of the food experiences your child has had or the memos sent home for you?

9. Do you feel the time your child spent learning about basic food and nutrition principles was worthwhile?

10. What did you like best about this experience?

11. What did you like least about this experience?

12. What could we do next time to improve the program?

13. Anything you wish we would have added or covered in greater detail?