Does the "Veggie U" Curriculum Increase Nutritional Knowledge, Self-Efficacy, Outcome Expectations, and Preferences Related to Fruits and Vegetables in 5th Grade Children?

By

RYAN FIDDLER

Master of Nutritional Sciences

Oklahoma State University

Stillwater, OK

2009

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE OR ARTS
May, 2009

Does the "Veggie U" Curriculum Increase Nutritional Knowledge, Self-Efficacy, Outcome Expectations, and Preferences Related to Fruits and Vegetables in 5th Grade Children?

Thesis Approved:

Dr. Lenka H. Shriver

Thesis Adviser

Dr. Deana Hildebrand

Dr. Doug Smith

Dr. A. Gordon Emslie

Dean of the Graduate College

ACKNOWLEDGMENTS

I would like to give thanks to several people. Without their help this thesis would have never been completed. First I would like to say thank you to my graduate advisor Dr. Lenka H. Shriver. Thank you for your guidance and patience. I have learned so much about the research process throughout this project and feel prepared to conduct more and better research in the future. I would also like to say thank you to my two committee members, Dr. Deana Hildebrand and Dr. Doug Smith. Thank you for supporting my research and offering your advice and constructive criticism. I would like to say thank you to the faculty at Richmond Elementary School, Principal Dr. Darren Nelson and 5th grade science teacher Deedee Liebenau. Without their approval and assistance this research would not have been possible. And lastly, I would like to thank Chris Kirby, Farm-to-School Director at the Department of Oklahoma Agriculture, Food, and Forestry for providing the financial support to conduct this research.

TABLE OF CONTENTS

Chapter Page

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

INTRODUCTION

Childhood Overweight and Obesity

Childhood overweight and obesity has become one of the United States greatest health concerns. There are a variety of health-related consequences associated with overweight and obesity, some of which are immediate threats and others more long-term. Overweight and obesity increase the risk of several conditions and chronic diseases such as low self-esteem, hypertension, hypercholesterolemia, type 2 diabetes mellitus, and cardiovascular disease amongst several others [1-8].

There are also additional psychosocial risks that have been linked to overweight and obesity. For instance, obese children and adolescents are often discriminated against in social settings [2]. This can lead to low-self esteem which can then lead to poorer academic achievement and social functioning [3]**.** More importantly, obese children and adolescents are at a greater risk of becoming obese as adults than are non-obese children and adolescents [9, 10]. One study found that nearly 80% of overweight adolescents aged 10-15 years old became obese adults by the time they reached 25 years of age [9].

The consequences of obesity are vast and may impair long-term health and decrease an individuals' quality of life. Children and adolescents who are obese have been found to have risk factors for cardiovascular disease such as hypertension, hyperlipidemia, and impaired glucose tolerance [2]. In a recent study it was found that 70% of obese children had at least one risk factor for cardiovascular disease and 39% of

obese children had at least two risk factors for cardiovascular disease [5]. Historically childhood and adolescent hypertension has affected between 1% and 3% of the population [6], however, findings from a recent study involving over 5000 children found hypertension to be present in 5% of the population studied [7]. Furthermore, the strongest risk factor associated with hypertension was obesity (relative risk, 3.3). Hypercholesterolemia, a cardiovascular disease risk factor, has also been associated with obesity. Results from the 2003-2004 National Health and Nutrition Examination Survey (NHANES) showed that 10% of children and adolescents had total serum cholesterol above 200 mg/dL, which is categorized as borderline high. The Bogalusa Heart Study, a longitudinal study involving more than 27,000 subjects ages 5-24 years old, examined cardiovascular risk factors and found that BMI was the strongest predictor of high cholesterol levels [4].

Rates of type II diabetes mellitus in children and adolescents have been increasing alongside rates of overweight and obesity in children and adolescents [8]. The metabolic syndrome is a grouping of the most significant risk factors for type 2 diabetes mellitus and cardiovascular disease. Presently 7% of overweight adolescents, 29% of obese adolescents, and 50% of severely obese adolescents suffer from metabolic syndrome [1, 11]. In a two year longitudinal study involving over 100 obese children and adolescents severe obesity and impaired glucose tolerance were found to be the best predictors of developing type 2 diabetes [12].

Since the 1970s, the prevalence of overweight among 6-19 year olds has more than tripled [13, 14]. Similarly, the prevalence of obesity has more than doubled in children ages 2-5 years and tripled in children ages 6-11 and 12-17 years [13]. One of the *Healthy People 2010* objectives is to reduce childhood and adolescent obesity to less than 5% [15]. Although recognition of the problem has been addressed and efforts have been made to reverse these trends childhood overweight and obesity rates still remain high. In 2005-2006, 30.1% of children were at or above the 85th percentile of BMI for age [16]. Obesity-related healthcare costs have increased in a parallel manner alongside obesity rates; among 6-17 year olds obesity-related healthcare costs have tripled over the past twenty years, reaching $127 million per year [17].

Several factors that contribute to overweight and obesity among children have been identified in previous research, including a variety of genetic, behavioral, and environmental factors. Individual causes of child obesity have proved to be extremely difficult to identify because a wide variety of factors are likely to play a role in the development of excess adiposity among children. While certain genetic factors have been shown to contribute to an individual's susceptibility to excess weight they cannot explain the rapid rise in rates of overweight and obesity in the general population [18, 19].

Obesity results from a positive energy imbalance; this could occur from an increase in energy intake, a decrease in energy expenditure, or a combination of both. Data from the Nationwide Food Consumption Survey (NFCS) show that total energy

intake among children 2-18 years old increased from 1778 kcal/day in 1989-91 to 1958 kcal/day in 1994-1996 [20]. A closer look at the NFCS shows that these increases are associated with consumption of certain foods such as; salty snacks, candy, soft drinks, fruit drinks, French fries, cheeseburgers, and pizza [20]. Increased portion sizes have been shown to increase energy intake and risk of excess adiposity [21-25]. Similar to obesity rates, portion sizes have been steadily increasing over the last two decades [26-29].

Certain behaviors may potentially contribute to the development of obesity. Lack of physical activity, poor food choices, and increased sedentary behavior are all likely to contribute to the increasing rate of childhood overweight and obesity [4, 30-33]. Environmental factors can contribute to the ability to make behavioral changes regarding diet and physical activity. Several environments have been identified as locations that offer opportunities to improve engagement in physical activity and to eat a healthy diet.

Role of Fruits and Vegetables in Health

Fruit and vegetable consumption, has been shown to decrease the risk of chronic diseases such as obesity, cancer, and heart disease [34-37]. However, children's diets tend to be low in fruit and vegetable consumption [38]. Increasing consumption of low energy dense foods such as fruits and vegetables has been shown to reduce energy intake of children [39, 40]. This may be an effective strategy to reduce the rate of overweight and obesity in children while simultaneously improving children's diets.

School-age children may benefit from nutrition education and encouragement to consume healthy low energy dense foods such as fruits and vegetables. To evaluate the effectiveness of nutrition interventions several variables have been identified to be associated with increased intake of fruits and vegetables such as fruit and vegetable preferences, knowledge, self-efficacy, and outcome expectations.

Study Objectives

In a current review of the effectiveness of interventions aimed at promoting fruit and vegetable consumption in school-aged children, it was found that the interventions may be effective at increasing fruit and vegetable intake and knowledge related to fruit and vegetables. The purpose of this study was to evaluate the effectiveness of a nutrition education curriculum titled "Veggie U: Earth to Table" among 5th grade children in terms of fruit and vegetable knowledge, fruit and vegetable preferences, outcome expectations and self-efficacy related to fruit and vegetables. The "Veggie U: Earth to Table" curriculum was designed to teach school-aged children the importance of a healthful diet that includes fruits and vegetables; however, the effectiveness of this curriculum has not yet been evaluated in previous research.

Hypotheses

1) The Veggie U curriculum will have no significant effect on children's knowledge of fruits and vegetables within the intervention group.

2) The Veggie U curriculum will have no significant effect on children's preferences for fruits and vegetables within the intervention group.
3) The Veggie U curriculum will have no significant effect on children's fruit and vegetable self-efficacy within the intervention group.
4) The Veggie U curriculum will have no significant effect on children's fruit and vegetable outcome expectations within the intervention group.
5) The Veggie U curriculum will have no significant effect on children's familiarity with fruit and vegetables within the intervention group.

CHAPTER II

REVIEW OF LITERATURE

Childhood overweight and obesity has become one of the United States greatest health concerns. The consequences associated with overweight and obesity has been well documented. There are a variety of health-related consequences associated with overweight and obesity, some of which are immediate threats and others more long-term.

Prevalence of Childhood Overweight and Obesity

Since the 1970s the prevalence of overweight among 6-19 year olds has more than tripled [13, 14]. Similarly, the prevalence of obesity among children has more than doubled in children ages 2-5 years and tripled in children ages 6-11 and 12-17 years [13]. Data from the National Health and Nutrition Examination Surveys (NHANES) 1976-1980 and 2003-2006 shows an increase in obesity rates of children at all ages; obesity in children ages 2-5 years has increased from 5% to 12.4%, in children ages 6-11 years, prevalence has increased from 6.5% to 17%, and for children ages 12-19 years, rates of obesity have increased from 5.0% to 17.6% [16]. One of the Healthy People 2010 objectives is to reduce childhood and adolescent obesity to less than 5% [15]. Although recognition of the problem has been addressed and efforts have been made to reverse these trends childhood overweight and obesity rates still remain high. In 2005-2006,

30.1% of children were at or above the 85th percentile of BMI for age [16]. Obesity-related healthcare costs have increased in a parallel manner alongside obesity rates; among 6-17 year olds obesity-related healthcare costs have tripled over the past twenty years, reaching $127 million per year [17].

Measuring Childhood Overweight and Obesity

The Body Mass Index (BMI) is used to define overweight and obesity in children and adolescents. BMI is a measure of an individual's weight relative to their height. BMI is relatively easy to measure and calculate and is therefore used as a common screening tool for assessing overweight and obesity in various populations including children and adolescents. While BMI is not a direct measure of body fatness it has been shown to consistently correlate with body fatness in children and adolescents [41].

When applying BMI measurements to define overweight and obesity in children and adolescents (age 2-19 years) an individual's BMI is plotted on the Centers for Disease Control and Prevention (CDC) year 2000 growth charts, which is used to establish an individual's BMI-for-age percentile. The CDC defines "at risk for overweight" as a BMI at or above the 85th percentile and below the 95th percentile (equivalent to overweight in adults) and "overweight" as a BMI at or above the 95th percentile (equivalent to obese in adults) [42].

Obesity and Chronic Disease

Overweight and obesity in adults increases the risk of several conditions and chronic diseases such as hypertension, hypercholesterolemia, type 2 diabetes mellitus, and cardiovascular disease [1-8]. There are also psychosocial risks linked with overweight and obesity, for instance, obese children and adolescents are often discriminated against in social settings [2]. This can lead to low-self esteem which can then lead to poorer academic achievement and social functioning [3].

Children and adolescents who are obese also have been found to have risk factors for cardiovascular disease such as hypertension, hyperlipidemia, and impaired glucose tolerance [2]. In a recent study it was found that 70% of obese children had at least one risk factor for cardiovascular disease and 39% of obese children had at least two risk factors for cardiovascular disease [5].

Childhood and adolescent hypertension, when adjusted for age, sex, and height, is defined as a systolic and diastolic blood pressure at or above the 95^{th} percentile [43]. Historically childhood and adolescent hypertension has affected between 1% and 3% of the population [6], however, results from a recent study involving over 5000 children showed an increase nearly twice that at 5% [7]. Furthermore, the strongest risk factor associated with hypertension was obesity (relative risk, 3.3). The findings of this study are consistent with the findings of subsequent studies [44, 45]. Childhood hypertension has been shown to persist into adult hypertension, thus increasing the risk of coronary artery disease and stroke [46].

According to the U.S. Health and Human Services National Institutes of Health total cholesterol recommendations are as follows: less than 200 mg/dL is desirable, 200-239 mg/dL is borderline high, and 240 mg/dL and above is high. Results from the 2003-2004 National Health and Nutrition Examination Survey (NHANES) showed that 10% of children and adolescents had total serum cholesterol above 200 mg/dL. The Bogalusa Heart Study, a longitudinal study involving more than 27,000 subjects ages 5-24 years old, examined cardiovascular risk factors and found that children's BMI was the strongest predictor of high cholesterol levels [4]. Therefore, childhood overweight is strongly linked to future risk of heart disease as well.

Alongside rates of overweight and obesity, the prevalence of type II diabetes mellitus has also been increasing in children and adolescents [8]. The metabolic syndrome is a grouping of the most significant risk factors for type 2 diabetes mellitus and cardiovascular disease. Recently the International Diabetes Federation (IDF) constructed a definition for metabolic syndrome in children and adolescents that is consistent with that of adults [47]. The IDF suggests children under 10 years of age not be diagnosed with metabolic syndrome but should be strongly encouraged to reduce weight if abdominal obesity is present. For children ages 10-16 years old metabolic syndrome is defined as having a waist circumference greater than the 90^{th} percentile plus two or more of the following; raised triglyceride level (>150 mg/dL), reduced HDL cholesterol (<40 mg/dL), raised blood pressure (systolic >130 mm Hg or diastolic > 85 mm Hg), or raised fasting plasma glucose (> 100 mg/dL). The metabolic syndrome has

been increasing in children and adolescents similarly to increases in obesity; presently 7% of overweight adolescents, 29% of obese adolescents, and 50% of severely obese adolescents have metabolic syndrome [1, 11]. In a study comparing severely obese (>99.5th percentile for BMI) and moderately severe (97th-99.5th percentile for BMI) obese children and adolescents with overweight and non-overweight children, it was found that increasing categories of obesity were correlated with increases in fasting glucose, fasting insulin, triglycerides, systolic blood pressure, decreased HDL cholesterol, and the incidence of impaired glucose tolerance. Metabolic syndrome was present in 30% of the moderately severe obese subjects and in nearly 50% of the severely obese subjects [48]. In the previously mentioned Bogalusa Heart Study, individuals in the 99th percentile for BMI had a much higher incidence of metabolic syndrome components and a higher predictive value for an adult BMI >35 kg/m^2 [5]. In a two year longitudinal study involving over 100 obese children and adolescents severe obesity and impaired glucose tolerance were found to be the best predictors of developing type 2 diabetes [12]. In addition to the diseases mentioned earlier, obesity has also been associated with an increased risk of several other diseases such as; cancers (endometrial [49], colon [50], and breast [51]), liver and gallbladder disease [52, 53], sleep apnea and respiratory problems [54], osteoarthritis [55], and gynecological problems (abnormal menses, infertility) [56].

Childhood obesity is of great concern because obese children and adolescents are at a greater risk of becoming obese as adults than are non-obese children and adolescents

[9, 10]. One study found that nearly 80% of overweight adolescents aged 10-15 years old became obese adults by the time they reached 25 years of age [9]. Similar findings have been observed in obese adults where weight history of obese individuals was tracked to their childhood. A study by Freedman, 2001 [57] found that 25% of obese adults were overweight as children. The severity of obesity in adulthood is also connected with its onset in childhood. In the same study mentioned previously, it was discovered that if overweight starts before the age of 8 years obesity in adulthood is more severe than for those children who became overweight at a later age [57].

Energy Imbalance

Most experts agree that obesity results from a positive energy balance; this could occur from an increase in energy intake, a decrease in energy expenditure, or a combination of both [58]. Although most studies do not show a relationship between total energy intake and childhood obesity, studies do show that children are consuming, on average, 10% more calories presently than just 15 years ago [20]. This disparity most likely can be attributed to the difficulty of accurately assessing dietary intakes using dietary assessment tools such as dietary recalls and food frequency questionnaires. These methods are subject to underreporting [59].

Factors Contributing to Childhood Obesity

While positive energy balance leads to the development of obesity over time, several factors that contribute to the energy imbalance have been identified in previous research including genetic, behavioral, and environmental factors. However, individual causes of child obesity have proved to be extremely difficult to indentify because a wide variety of factors are likely to play a role in the development of excess adiposity among children. Twin studies have estimated that adiposity may be 40-70% inheritable [18, 60]. Several genes have been identified that may contribute to obesity. However, the number of people in the general population with these genetic propensities is much lower than the number of people who are obese. For example, individuals with a defect in the leptin or leptin receptor gene and the hypothalamic leptin-melancortin pathway are estimated to affect less than 2% of obese adults [60]. While certain genetic factors have been shown to contribute to an individual's susceptibility to excess weight they cannot explain the rapid rise in rates of overweight and obesity in the general population [18, 19].

There is strong evidence that varieties of behavioral factors are associated with the development of excessive adiposity and thus are responsible, in part, for the increasing rates of childhood obesity in the U.S. and other countries. Poor dietary choices, lack of physical activity, increased sedentary behavior, and other unhealthy behaviors all contribute to the increasing rate of childhood obesity [4, 30-33].

Data from the Nationwide Food Consumption Survey (NFCS) show that total energy intake among children 2-18 years old increased from 1778 kcal/day in 1989-91 to

1958 kcal/day in 1994-1996 [20]. A closer look at the NFCS shows that these increases are associated with certain foods such as; salty snacks, candy, soft drinks, fruit drinks, French fries, cheeseburgers, and pizza [20]. In addition, 50% of the increase in energy intake can be attributed to increases in consumption of sugar-sweetened beverages [61]. A current review of the dietary factors contributing to childhood obesity found sugar-sweetened beverages to be the single high-risk dietary practice linked to overweight in children [62].

Increased portion sizes have been shown to increase energy intake and risk of excess adiposity [21-25]**.** Similar to obesity rates, portion sizes have been steadily increasing over the last two decades [26-29]. Very young children, 2-3 years old, do not seem to be affected by this; however, as children age portion sizes have a profound effect on energy intake [21, 63]. Several studies have demonstrated the effect of increased portions sizes resulting in increased energy intakes in children as young as 4 and 5 year olds and also in adults [22, 25, 63, 64]. The effect of large portions on energy intake has been shown to be reduced by permitting children to serve themselves. One study showed that children ate 25% less of a large entrée when allowed to determine their own portion sizes compared to having the larger portion sized served to them [65]. In addition, education and encouragement of appropriate portion sizes may have the potential to reduce children's energy intake and reduce childhood overweight and obesity.

Not only are children consuming more energy than in the past, they also consume more foods that are low in nutrient density and high in energy, especially sugar-

sweetened beverages. Additionally, only 25% of children and adolescents are consuming the minimum recommended five half-cup servings of fruits and vegetables per day [66]. Because consumption of these foods has been shown to be protective of obesity, children should be encouraged to increase intake of these foods and replace the low-nutrient density foods with other more healthy and nutrient-dense food choices [62].

Behavioral changes related to physical activity in the past several decades are also believed to be responsible for increased obesity rates in the U.S. American children today are less active than were previous generations of children; lack of physical activity has been shown to increase risk of overweight, hypertension, hyperlipidemia, and hypercholesterolemia [4, 30]. Current physical activity recommendations from the Centers for Disease Control (CDC) suggest children engage in at least 60 minutes of moderate-intensity physical activity daily. Presently only 28% of high school students meet the current recommendations [67]. Adolescent participation in physical education at school has dropped from 41% in 1991 to 28% in 2003 [68]. Physical activity can contribute to reducing childhood overweight and obesity, and may also reduce blood pressure and improve bone health [69]. Encouraging children to engage in physical activity at a young age may persist into adulthood. Studies show that physically active children are more likely to be active as adolescents and possibly as adults and thus may have a lower risk of obesity compared to those who are inactive [70].

As rates of physical activity have decreased in the past thirty years, the prevalence of sedentary behaviors through increases in electronic media has likely increased in

children [71]. Sedentary behavior is another contributing factor to the increasing rates of overweight and obesity among children. Multiple studies have shown a positive association with television viewing time and prevalence of obesity in children [31-33]. NHANES III 1988-1994 data showed that 26% of US children watched 4 or more hours of television per day. Furthermore, children who watched 4 or more hours of television per day had a significantly higher BMI than those who watched less than 2 hours per day [72]. In addition to displacing time children may spend participating in physical activity [73, 74] television viewing and other media engagements (movies, video games and internet viewing) may also result in increased energy intake through excessive snacking [75, 76] and lower children's metabolic rates [77].

Several environmental variables have also been associated with the development of obesity among adults and children. Environmental factors can contribute to the ability to make behavioral changes regarding diet and physical activity. Several different types of environments have been identified as locations that offer opportunities to improve engagement in physical activity and to eat a healthy diet [58]. For example, at home opportunities exist to reduce television viewing time and improve dietary habits of children. Parents serve as role models for their children and can therefore influence behaviors such as engagement in physical activity, sedentary behaviors, and dietary choices [58]. Schools can offer breakfast and lunch options that are low-fat, nutrient dense and meet nutritional recommendations. They can reduce availability of foods that are high in fat and added sugars. Schools can also provide children and adolescents with

the opportunity to participate in daily physical activity and physical activity education. At the community level several opportunities exist to improve behavioral factors. Communities can request availability of sidewalks and parks that provide opportunities for physical activity. In communities that lack sidewalks, bike paths, and neighborhood parks children may be discouraged to walk or bike to school or participate in physical activity [58]. Communities can ask grocers to provide healthier food choices and promote the consumption of the daily recommended servings of fruits and vegetables. Lack of availability of reasonably priced, healthful foods has been shown to be a barrier to purchasing healthy foods [78]. The school environment is an excellent place to educate children on the importance of a healthful diet that includes a large proportion of fruits and vegetables. While several nutrition education curriculums exist, few have been evaluated for effectiveness using an evidence-based approach and even fewer evaluation results have been published.

Recommendations for Fruit and Vegetable Intake

Fruit and vegetable consumption, has been shown to decrease the risk of chronic diseases such as obesity, cancer, and heart disease [34-37]. However, children's diets tend to be low in fruit and vegetable consumption [38]. The United States Department of Agriculture (USDA) sets minimum daily recommendations for all five food groups. Daily amounts for each food group are based on 12 different calorie levels. For a child requiring 2000 kcal per day, which represents a 10 year old female engaging in the

recommended 60 minutes of daily physical activity, requirements are 2 cups (4 servings) of fruit and 2.5 cups (5 servings) of vegetables, for a male of the same age and activity level, vegetable recommendations increase to 3 cups, yet only 25% of US children are eating 5 half-cup servings or more of fruits and vegetables combined daily [66]. Therefore, it is important to find effective means of increasing fruit and vegetable consumption among children.

Health Benefits of Fruits and Vegetables

The benefits of fruit and vegetable consumption have been well documented. Several studies have shown that fruit and vegetable consumption reduces the risk of cardiovascular disease and stroke [35, 79-82]. Fruits and vegetables have also been shown to reduce the risk of several types of cancer such as: colorectal, prostate, lung, oral cavity, breast, esophagus, stomach, pancreas, uterine cervix, and ovarian cancers [83-86]. The mechanism has yet to be determined, however, many hypotheses exist. Fruits and vegetables are excellent sources of carotenoids, vitamins C and E, folate, dietary fiber, and many phytochemicals most of which may inhibit several types of cancer [87]. Carotenoids and vitamins C and E are believed to reduce reactive oxygen species, which may reduce oxidative DNA damage and mutations and support immune responses [88, 89]. Inadequate folate intake may result in dysfunctional DNA synthesis negatively affecting cell proliferation in the immune system [90].

Increasing consumption of fruits and vegetables may also reduce childhood overweight and obesity. Fruits and vegetables are generally low in fat and energy density (kcal/g) and have high concentrations of water and dietary fiber [91]. Energy density is defined as the amount of energy in a given weight of food [92]. Fruits and vegetables are believed to affect body weight due to their low-energy density and high fiber and water content as opposed to their specific macronutrient composition [93]. Many obesity prevention and treatment interventions for children and adults suggest decreasing intake of high-fat, high-sugar foods and restricting energy intake [42, 94]. However, these strategies have often only moderate success, are short-lived, and/or may result in dissatisfaction and feelings of hunger among children [92]. Another approach less commonly used is to encourage intake of high nutrient-dense foods such as fruits and vegetables with the intention of displacing intakes of high-fat, high-sugar foods without restricting calories. Studies have shown that people tend to eat the same amount of food day-to-day with regard to weight [95]. Furthermore, laboratory-based studies have also shown people consume less energy when presented with lower energy dense foods (e.g., fruit and vegetables) than compared to similar foods of the same weight with a higher energy density [96-99]. Studies have also shown that energy densities effect total energy intake and weight status in free-living persons [92, 100, 101]. For example, in one study using this approach subjects (obese parents with non-obese children) were placed in one of two intervention groups; an “increase fruit and vegetable” group or a “decrease high-fat, high-sugar” group. Results showed the “increase fruit and vegetable” group not only

significantly increased fruit and vegetable consumption but also significantly decreased high-fat, high-sugar food intake and showed a greater decrease in percentage of overweight than the “decrease high-fat, high-sugar” group after one year [101]. Other studies have determined this approach is effective for children as well. The results of two of these studies showed that decreasing the energy density of foods served yielded significant reductions in energy intakes of 14% and 18% [39, 40]. The results were consistent across children with all BMI percentiles. In both of these studies energy density reduction was achieved by decreasing fat and sugar and increasing fruit and vegetables. This approach may lead to dietary changes that both reduce energy intake while simultaneously improving diet quality.

Contrary to popular belief, several short term studies have indicated that feelings of satiety are achieved, with fewer calories consumed, when given low-energy density foods compared to high-energy density foods [98, 102-104]. For example, in one study participants were given low-energy density foods then high-energy density foods of equal volume on alternating days for 5 days. Subjects reported feeling full on nearly half the calories (1570 kcal compared to 3000 kcal) when given the low-energy density foods compared to the high-energy density foods [103]. Reducing energy density in these studies was achieved by either substituting vegetables for more energy dense foods or by incorporating characteristics similar to the properties of fruits and vegetables such as increasing the water content or decreasing fat content of the foods served. Short term

studies have indicated that low-energy density diets improve satiety and reduce hunger while decreasing energy intake.

In a comprehensive review of long-term studies (6 months or greater) on the effect of energy density on weight loss, results showed that low-energy density diets characterized by low-fat and high-fiber content yielded weight loss three times greater than low-fat only diets [105]. When considering the benefits of fruits and vegetables regarding energy density, the form of the food was important, especially for fruits. When consumed whole as opposed to puree or as juice, fruits provide greater satiety probably due to their higher water and fiber content [106, 107]. In studies testing the effectiveness of vegetables increasing satiety similar results have been found; satiety was positively correlated with fiber content [108-111]. Other studies focusing on fiber content alone, not exclusively associated with fruits and vegetables have shown a positive association with weight loss. In a review of 22 studies on the effects of a high-fiber diet compared to a low-fiber diet, 20 out of 22 showed the high-fiber diet resulted in weight loss [112].

Extensive research has been conducted on the relationship between energy density of food and energy intake and the role fruits and vegetables play in effectively reducing energy density. However, the direct relationship of fruits and vegetables on body weight has not been thoroughly researched. Most studies have focused on a specific condition or disease and the role fruits and vegetables may play in treating or reducing symptoms of such conditions, however, many of these studies have also reported on weight loss as a secondary measure. For example, in the Multiple Risk Factor Intervention Trial

(MRFIT) subjects were asked to increase fruit and vegetable intake to more than 5 servings a day as well as decrease fat intake below 35% of total calories and increase consumption of grains. The results showed that those who increased fruit and vegetable consumption maintained weight loss and those with the highest fruit and vegetable consumption lost the most weight [113]. In another study 213 obese adults were encouraged to reduce energy intake by consuming more low-fat high-complex carbohydrate foods such as fruits and vegetables. Results indicated 69% of the subjects lost an average of 13.9 lbs and after a two year follow-up over 50% had increased or maintained their weight loss [114]. In a study conducted by Rock et al, 1010 women previously treated for breast cancer were advised to either increase consumption of fruits and vegetables and fiber while reducing fat intake to 15-20% of total energy (treatment group) or were given general dietary guidelines (control). The primary measure was the effect of decreasing fat intake on BMI. Results indicated no significant difference between groups with regard to changes in BMI and fat intake; however, in both groups increases in vegetables and fiber intake were associated with decreases in BMI, independent of other dietary factors [115]. In several studies of cardiac patients aimed at decreasing blood lipid profiles, decreasing risk of another myocardial infarction, or slowing the progression of coronary artery disease increasing consumption of fruits and vegetables and decreasing fat intake were recommended. While weight loss was not directly advised to any of the subjects, follow-up results indicated that as a group subjects lost a significant amount of weight [116-118].

Few epidemiological studies exist designed to specifically assess whether there is an association between fruit and vegetable intake and body weight. Furthermore, the studies available differ in their methodology and show inconsistent results. In a study researching data from the Behavioral Risk Factor Surveillance System no difference in fruit and vegetable consumption was found between normal weight women and overweight women or any weight category among men [119]. Using data from the Continuing Survey of Food Intakes by Individuals (CSFII) researchers found significantly fewer vegetables were consumed by obese men than men in lower categories of BMI [120]. On the contrary, no difference in vegetable consumption was seen between women of different BMI categories. Fruit consumption was significantly lower in both obese men and women however. Lastly, in the Cancer Prevention Study II, a negative association was shown between vegetable intake and BMI and waist circumference in both women and men over a period of 10 years [121]. More epidemiological studies are needed to better understand the relationship between fruit and vegetable intake and weight loss, especially in children. However, given the results of several clinical trials with adults and children there is strong evidence that fruit and vegetables are protective of obesity [39, 40, 101, 103, 105].

Obesity Prevention Intervention

An important aspect to interventions aimed at obesity prevention is at what age they should begin. Studies show that children learn eating behaviors at a very early age.

Surveys have identified a strong correlation between early food exposure and food acceptance. In a cross-sectional survey of 564 mothers of preschool children, exposure to fruits and vegetables after weaning resulted in greater consumption of fruits and vegetables at ages 2-6 years [122]. In another study repeated exposure to a variety of fruits and vegetables in the first two years of life correlated with an increased variety of fruits and vegetables consumed during ages 6-8 years [123]. This demonstrates the importance of early exposure to a variety of fruits and vegetables, however, once a child reaches school-age they start to make independent choices regarding their diets and peer-influence begins to affect their dietary choices [124, 125]. Therefore, school-age children may benefit from nutrition education and encouragement to consume healthy foods to counter the impact of peer and other influences at that age. Previous research has identified several variables associated with increased fruit and vegetable intake. These variables are often used to evaluate the effectiveness of an intervention to promote increased consumption of fruits and vegetables [126, 127].

Factors Associated with Fruit and Vegetable Intake

Previous research shows that variables such as fruit and vegetable preferences, knowledge, self-efficacy, and outcome expectations have all been associated with increased fruit and vegetable consumption. These variables are considered determinants of modifying health behaviors within the Social Cognitive Theory (SCT) model [128]. The SCT model has been used in dietary interventions in previous research [129, 130].

Fruit and vegetable preferences have been shown to be associated with increased fruit and vegetable consumption in both children and adults in several studies [127, 128, 131-140]. In a study conducted by Resnicow et al [128], 1398 third grade students (mean age 8.7 years) were asked to complete a 20-item fruit and vegetable preference questionnaire. Students also completed similar questionnaires with regard to self-efficacy, outcome expectations, health knowledge and a 7-day food diary to measure fruit and vegetable intake. Results showed that fruit and vegetable preferences were strongly correlated with fruit and vegetable intake. In a similar study 473 boy scouts with an average age of 12.8 years completed questionnaires regarding fruit, 100% juice, and vegetable preferences, self-efficacy, home availability, and social desirability. Results showed preferences to be significantly associated with fruit and 100% juice consumption. When combined with home availability preferences showed a significant association with vegetable consumption [131]. Another study composed of 207 school-children 11-12 years old measured similar psychosocial determinants of fruit and vegetable consumption such as preferences and self-efficacy, again preferences were found to have the highest correlation with consumption [136]. In a larger cross-sectional survey of 2468 school-children aged 11 years old fruit and vegetable consumption was most positively correlated with fruit and vegetable preferences once again [139].

Knowledge related to fruits and vegetables has also been shown to be strongly associated with increased fruit and vegetable consumption among adults and children [141-144]. In a survey conducted with 2811 adults to estimate knowledge of daily fruit

and vegetable recommendations results indicated that only 8% of adults knew the current recommendations suggested eating a minimum of 5 servings of fruits and vegetables daily. Furthermore, the amount of fruit and vegetable servings adults believed they were supposed to eat daily had more impact on their daily consumption of fruit and vegetables than did taste preferences or childhood eating practices [143]. In a similar survey of 2605 adults, knowledge of the 5 a Day Message was associated with a 22% increase in fruit and vegetable consumption [142]. Fruit and vegetable knowledge has also been shown to be associated with an increase in fruit and vegetable intake in children [141, 144]. A recent study developed, implemented, and evaluated a school-based intervention for 5-7 year olds. Subjects (n= 213) were randomly assigned to a control group or one of three intervention groups; nutrition, physical activity, or nutrition and physical activity. Highly significant improvements in nutrition knowledge were seen in the nutrition and combined groups. In addition, overall fruit and vegetable intake significantly increased in all groups [141]. Another observational study on the determinants of fruit and vegetable intakes amongst 11-12 year old school-children found knowledge to be associated with a greater intake of fruits and vegetables [144].

Self-efficacy (or self-confidence) related to fruits and vegetables has also been associated with increased fruit and vegetable consumption in previous research [131, 136, 139, 142, 145-151]. Fruit and vegetable self-efficacy is defined as the ability to select, prepare, and eat fruits and vegetables [131]. In a survey of 736 middle school students ages 11-15 years, self-efficacy was found to be the strongest correlate of choosing fruits

and vegetables as a snack choice [147]. In a cross-sectional survey involving 2468 eleven year old school-children fruit and vegetable intake and potential correlates, including self-efficacy, were measured using self-administered questionnaires. Results indicated self-efficacy was one of the strongest correlates of fruit intake [139]. In another study designed to investigate potential psychosocial correlates of fruit and vegetable intake involving 473 boy scouts results showed a significant correlation between fruit and vegetable self-efficacy and intake [131]. In a study involving 3122 mothers enrolled in the Special Supplemental Nutrition Program Women, Infants, and Children (WIC) results showed an increase of one standard deviation in fruit and vegetable self-efficacy produced a mean daily increase of .76 servings of fruits and vegetables [150].

Outcome expectations are defined as the perceived positive and negative consequences of a behavior [152]. Fruit and vegetable outcome expectations have been shown to be associated with increased fruit and vegetable consumption, however, most evidence exists in adult populations with mixed results found in populations of children [128, 153, 154]. A random digital-dial survey of 838 adults showed fruit and vegetable outcomes expectations were strongly correlated with vegetable intake [153]. In a similar cross-sectional survey involving 1450 adults, intrinsic motivations for eating a healthful diet (outcome expectations) were strongly associated with fruit and vegetable intakes [154].

CHAPTER III

METHODOLOGY

Research Design and Sampling Procedure

This intervention study was conducted in the fall of 2008. A convenience sample of children from one elementary school and three different classrooms in a mid-western state in the U.S. were recruited for the study. Two classrooms participated in the intervention while one classroom served as the control group. All children attended 5th grade at the time of this study.

The school principal was contacted via phone and agreed to participate in the study after being given a thorough explanation of the study. The principal received and signed an informed written consent (Appendix B). The 5th grade science teacher also received and signed a teacher confidentiality agreement (Appendix C). The study protocol was approved by the Institutional Review Board at Oklahoma State University (Appendix A).

Subject recruitment

After receiving the signed written informed consent form from the principal and the signed written teacher confidentiality agreement from the 5th grade science teacher, children from the three selected classes were given a written detailed description of the study and a written informed consent form to be taken home and signed by parents (Appendix D). In addition, written informed assent forms were signed by the children upon receipt of signed parental informed consent forms (Appendix E). Two classrooms

were randomly assigned as intervention groups and one classroom served as a control group during the study.

Intervention

The intervention groups received a five week nutrition education intervention that was delivered as part of science classes in the classroom setting between September and October of 2008. The intervention utilized the "Veggie U: Earth to Table" which is a science-based curriculum designed to improve children's knowledge of nutrition, with a focus on making wise food choices. The Veggie U curriculum was designed to be hands-on and participative with the ultimate goal to illicit behavior change regarding fruit and vegetable knowledge and consumption combating the rising epidemic of childhood obesity and connecting children to the relationship between nutrition and agriculture. A group of Master Teachers designed the curriculum over the course of 18 months with the assistance of a nutritionist and a physician. The five week intervention was planned to last approximately forty-five minutes every day. Each week the children learned specific objectives from the Veggie U curriculum taught by the fifth grade science teacher. Week one focused on the USDA's MyPyramid for Kids and planting vegetable seeds to be grown in the classroom. The second week of the Veggie U curriculum gave the children an overview of plant parts and soil. The third week focused on healthy eating, more specifically, balancing energy, understanding food labels, the importance of variety in the diet, and introduced children to the nutrients found in fruits and vegetables. Week four concentrated on how plants grow. During the final week the children learned about meal planning, ultimately planning their own meal with vegetables they had grown in class for

the final day. The intervention utilized nutrition education lectures accompanied with seeds, soil, flats, root view boxes, grow lights, and a worm farm for a hands-on experience allowing the children to see, hear, feel, and taste the process of planting, growing, harvesting and ultimately eating the vegetables they grew. The Veggie U kits were provided by the Oklahoma Department of Agriculture, Food, and Forestry.

Data Collection, Procedures, and Instrumentation

Children completed one questionnaire administered in the classroom measuring several psychosocial scales adapted from previous research and demographic information including age, gender and race. Instruments included measurements of fruit and vegetable knowledge (6 items), preferences (37 items) [138], self-efficacy (21 items), and outcome expectations (12 items) [126], (Appendices K-I). Multiple choice and true-false items were used to measure knowledge, and 3-point scale items (e.g. I don't like it, I like it a little, I like it a lot) were used to measure preferences. Self-efficacy was measured using 5-point scale items (e.g. I disagree very much, I disagree a little, I am not sure, I agree a little, I agree very much) and outcome expectations was measured using a 3-point scale item (e.g. disagree, not sure, agree). Sum scores were created by adding individual items for each scale. The questionnaires were administered by the 5^{th} grade science teacher over the course of three days one week prior to the intervention and then again over three days, three weeks after the completion of the intervention. All questionnaires had been previously validated using Cronbach's alpha to assess reliability (outcome expectancies $\alpha = .67$, self-efficacy $\alpha = .86$, [155] and preferences $\alpha = .81$, [126]); however, the knowledge questionnaire was modified from the "Five a Day Power Play!"

Survey [126] and the Harvest of the Month Survey developed by the Network for a Healthy California to reflect the essential pieces of knowledge the intervention sought to provide.

Statistical Analysis

Descriptive statistics were used to summarize demographic characteristics of the entire sample and the intervention and control group including race, gender and age. Independent t-tests were used to determine whether differences in the main measured variables exist between the intervention and control groups at pretest and posttest. Student's paired t-test was used to detect potential significant differences in the main variables within the control and intervention groups from pretest to posttest. Statistical Package for the Social Sciences (SPSS) (version 16.0, 2008, Chicago, IL) was used to perform all statistical tests in the study. The significance for all analyses was set at $p<0.05$.

CHAPTER IV

FINDINGS

A total of 38 5th grade children participated and completed the study (n=20 in the intervention groups and n=18 in the control group). The average ages of the intervention group and control group were 10.3±.47 years and 10.0±0 years, respectively. Boys accounted for 52.6% of the entire sample and girls accounted for 47.4% of the sample. The children participating in the study were primarily Caucasian (61.5%) and American Indian (25.6%), with the rest being Latino/Hispanic (5.1%), Asian/Pacific Islander (2.6%) and African American (2.6%) (Figure 1). Although a total of 60 children (and their parents) volunteered to participate in the study, complete data from the pretest and posttest measurements was obtained from only 63% of the children (n=38).

Students paired t-test analysis within the intervention group yielded a significant increase in familiarity with fruits and vegetables from pretest to posttest ($p<0.05$) (Table 1). There was also a trend observed within the intervention group in children's fruit and vegetable knowledge which increased from pretest to posttest, however this increase was not statistically significant ($p=0.061$). No significant changes were observed in the children's fruit and vegetable preferences, self-efficacy, or outcome expectations. Paired t-test analysis within the control group showed no significant difference between fruit and

vegetable knowledge, preferences, self-efficacy, outcome expectations, or familiarity from pretest to posttest (Table 2).

Independent t-test analysis indicated that there were no significant differences in fruit and vegetable knowledge, preferences, self-efficacy, outcome expectations or familiarity between the intervention and control groups at pretest (Table 3) or posttest (Table 4).

Figure 1: Racial Distribution of Children Participating in the Study

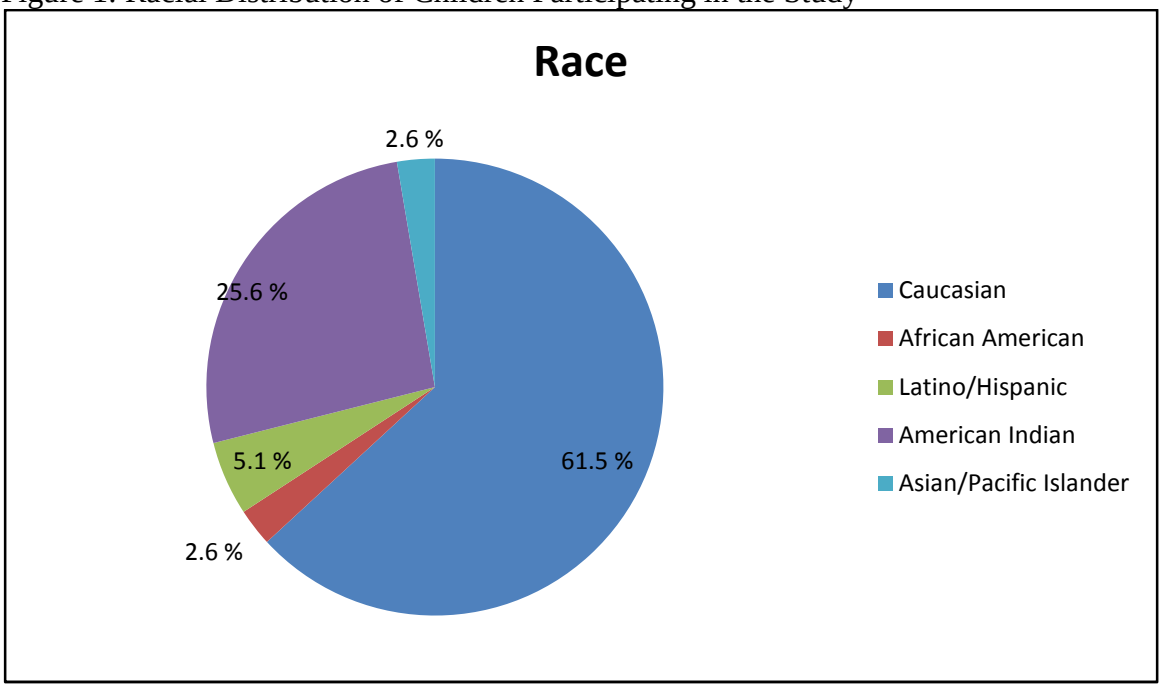

Table 1: Comparison of Knowledge, Preferences, Self-efficacy, Outcome Expectations and Familiarity related to FV within the Intervention Group between Pre-test and Post-test

Paired T-Test Intervention	**Pretest**	**Posttest**	
Variables	Mean±SD	Mean±SD	P-value
Total Knowledge [a]	2.90±1.07	3.45±0.94	.061
Total Preferences for Fruit [b]	47.55±8.97	47.15±12.96	.867
Total Preferences for Vegetables [c]	31.85±5.58	32.85±5.76	.470
Total Preferences for Fruit and Vegetables [d]	81.10±12.44	80.00±16.86	.719
Total Self-Efficacy [e]	87.65±15.03	87.60±17.56	.983
Total Outcome Expectations [f]	31.35±3.03	30.10±3.67	.091
Total Familiarity with Fruit and Vegetables [g]	32.40±3.98	35.05±2.04	.005**

a = Knowledge was measured using a 6 item scale; possible score ranged from 0-6
b = Preferences for fruit was measured using a 13 item scale; possible score ranged from 13-39
c = Preferences for vegetables was measured using a 24 item scale; possible score ranged from 24-72
d = Preferences for fruit and vegetables was measured using a 37 item scale; possible score ranged from 37-111
e = Self-efficacy was measured using a 21 item scale; possible score ranged from 21-105
f = Outcome expectations was measured using a 12 item scale; possible score ranged from 12-36
g = Familiarity was measured using a 37 item scale; possible score ranged from 0-37
**Indicates significance at $p<0.05$

Table 2: Comparison of Knowledge, Preferences, Self-efficacy, Outcome Expectations and Familiarity related to FV within the Control Group between Pre-test and Post-test

Paired T-Test Control	**Pretest**	**Posttest**	
Variables	Mean±SD	Mean±SD	P-value
Total Knowledge [a]	3.06±1.35	3.44±1.38	.310
Total Preferences for Fruit [b]	48.89±11.34	48.56±12.78	.880
Total Preferences for Vegetables [c]	29.61±6.62	30.83±6.08	.192
Total Preferences for Fruit and Vegetables [d]	79.83±14.88	79.39±16.15	.876
Total Self-Efficacy [e]	90.61±16.07	90.72±18.28	.961
Total Outcome Expectations [f]	30.67±3.53	29.89±4.48	.428
Total Familiarity with Fruit and Vegetables [g]	33.61±5.48	34.67±3.68	.468

a = Knowledge was measured using a 6 item scale; possible score ranged from 0-6
b = Preferences for fruit was measured using a 13 item scale; possible score ranged from 13-39
c = Preferences for vegetables was measured using a 24 item scale; possible score ranged from 24-72
d = Preferences for fruit and vegetables was measured using a 37 item scale; possible score ranged from 37-111
e = Self-efficacy was measured using a 21 item scale; possible score ranged from 21-105
f = Outcome expectations was measured using a 12 item scale; possible score ranged from 12-36
g = Familiarity was measured using a 37 item scale; possible score ranged from 0-37

Table 3: Pretest Comparison of Knowledge, Preferences, Self-efficacy, Outcome Expectations and Familiarity related to FV between the Intervention Group and Control

Independent T-Test	**Intervention**	**Control**	
Variables	Mean±SD	Mean±SD	P-value
Pretest Total Knowledge [a]	2.90±1.07	3.06±1.35	.695
Pretest Total Preferences for Vegetables [b]	47.55±8.98	48.89±11.34	.688
Pretest Total Preferences for Fruit [c]	31.85±5.58	29.61±6.62	.265
Pretest Total Preferences for Fruit and Vegetables [d]	81.10±12.44	79.83±14.88	.777
Pretest Total Self-Efficacy [e]	87.65±15.03	90.61±16.07	.561
Pretest Total Outcome Expectations [f]	31.35±3.03	30.67±3.53	.525
Pretest Total Familiarity with Fruits and Vegetables [g]	32.40±3.98	33.61±5.48	.437

a = Knowledge was measured using a 6 item scale; possible score ranged from 0-6
b = Preferences for fruit was measured using a 13 item scale; possible score ranged from 13-39
c = Preferences for vegetables was measured using a 24 item scale; possible score ranged from 24-72
d = Preferences for fruit and vegetables was measured using a 37 item scale; possible score ranged from 37-111
e = Self-efficacy was measured using a 21 item scale; possible score ranged from 21-105
f = Outcome expectations was measured using a 12 item scale; possible score ranged from 12-36
g = Familiarity was measured using a 37 item scale; possible score ranged from 0-37

Table 4: Posttest Comparison of Knowledge, Preferences, Self-efficacy, Outcome Expectations and Familiarity related to FV between the Intervention Group and Control

Independent T-Test	**Intervention**	**Control**	
Variables	Mean±SD	Mean±SD	P-value
Posttest Total Knowledge [a]	3.45±0.94	3.44±1.38	.988
Posttest Total Preferences for Vegetables [b]	47.15±12.96	48.56±12.78	.739
Posttest Total Preferences for Fruit [c]	32.85±5.76	30.83±6.08	.301
Posttest Total Preferences for Fruit and Vegetables [d]	80.00±16.86	79.39±16.15	.910
Posttest Total Self-Efficacy [e]	87.60±17.56	90.72±18.28	.595
Posttest Total Outcome Expectations [f]	31.10±3.67	29.89±4.48	.874
Posttest Total Familiarity with Fruits and Vegetables [g]	35.05±2.04	34.67±3.68	.690

a = Knowledge was measured using a 6 item scale; possible score ranged from 0-6
b = Preferences for fruit was measured using a 13 item scale; possible score ranged from 13-39
c = Preferences for vegetables was measured using a 24 item scale; possible score ranged from 24-72
d = Preferences for fruit and vegetables was measured using a 37 item scale; possible score ranged from 37-111
e = Self-efficacy was measured using a 21 item scale; possible score ranged from 21-105
f = Outcome expectations was measured using a 12 item scale; possible score ranged from 12-36
g = Familiarity was measured using a 37 item scale; possible score ranged from 0-37

CHAPTER V

CONCLUSION

This study investigated the effectiveness of a five week nutrition education curriculum titled "Veggie U: Earth to Table" on improving psychosocial variables associated with increased consumption of fruit and vegetables among 5th grade students. The results of this study indicated that the intervention effectively improved children's fruit and vegetable familiarity from pretest to posttest within the intervention group ($p<0.05$). In addition, children who received the 5-week intervention slightly increased their knowledge related to fruit and vegetables from pretest to posttest. However, the nutrition education intervention in this study failed to increase the other targeted psychosocial characteristics of the children, such as fruit and vegetable self-efficacy, preferences, and outcome expectations, which have been shown to be associated with increased fruit and vegetable consumption among children in previous research.

There is strong evidence that fruit and vegetable consumption among school-aged children is low in the U.S. As mentioned earlier, 75% of U.S. children are consuming fewer than the recommended five half-cup servings of fruits and vegetables combined daily [66]. According to the National Alliance for Nutrition and Activity, in the year 2000 only 1.9% of fruit and vegetables research projects funded by the USDA and the National Institute for Health (NIH) were devoted to increasing the consumption of fruit

and vegetables. In order to effectively increase fruit and vegetable consumption among school-aged children more research is needed that specifically targets this objective.

The results of the present study suggest that the Veggie U nutrition education curriculum can potentially improve familiarity with and knowledge related to fruit and vegetables among school-aged children. In our study, children in the intervention significantly increased their fruit and vegetable familiarity from pretest to posttest while children in the control group showed no change in fruit and vegetable familiarity. Although not a significant result, a positive trend ($p=0.061$) was also observed in children's fruit and vegetable knowledge in the intervention group between pretest and posttest. This finding is noteworthy because previous studies have demonstrated that improved nutrition knowledge often leads to increased fruit and vegetable consumption in different populations [141-144]. In a review of several nutrition education study results, 71% of studies reporting on knowledge outcomes showed significant increases in knowledge for the intervention groups compared to control groups [156]. The findings of this study did not result in a significant difference in fruit and vegetable knowledge, however a positive trend ($p=0.061$) in fruit and vegetable knowledge was observed within the intervention group from pretest to posttest, possibly suggesting a trend towards increasing fruit and vegetable knowledge over time. The short duration of the study or the small sample size may have limited the changes in fruit and vegetable knowledge among children participating in the study. Previous studies have shown that a minimum of 50 hours of nutrition education is needed to impact behavior whereas the students in

this study only received 18.75 hours [157, 158]. In the present study, the Veggie U curriculum that was administered in the classrooms was designed to last only forty-five minutes a day for five weeks. Thus, it is likely that a larger number of intervention sessions would have a greater positive impact on children's fruit and vegetable knowledge during the study. Another possible explanation for the statistically non-significant increase in fruit and vegetable knowledge could be that the evaluation method of children's knowledge was not specific enough to the Veggie U curriculum or was too short (only 6 items were included in the knowledge scale). Perhaps a new measure of fruit and vegetable knowledge that would be directly related to the Veggie U curriculum lessons should be developed in future research- in order to evaluate children's fruit and vegetable knowledge more accurately.

In our study, other psychosocial measures associated with fruit and vegetables, such as preferences for different types of fruit and vegetables, outcome expectations related to fruit and vegetables, and self-efficacy for eating fruit and vegetables were assessed. Although the Veggie U curriculum was not designed to specifically improve these variables the main purpose of the study was to evaluate the effectiveness of this curriculum in terms of increasing these psychosocial measures. Because of their strong association with increased fruit and vegetable consumption in previous studies, it could be expected that an increase in these psychosocial variables would lead to increased fruit and vegetable consumption among children. Previous studies have shown that fruit and vegetable preferences are one of the strongest predictors of fruit and vegetable intake in

children [127, 128, 131-140]. The results of this study showed no difference in fruit and vegetable preferences within the intervention group over time (pretest to posttest). Moreover, no differences in preferences were observed between the intervention and control groups at pretest or posttest. In previous studies, a strong interaction with fruit and vegetable preferences and fruit and vegetable home availability was observed [131, 138, 140]. Perhaps including data on home availability of fruit and vegetables in the present study would provide a better understanding of how children's fruit and vegetable preferences change over time and when combined with nutrition education interventions. Parents play a critical role in promoting healthy eating habits; parent's behavior can either support or counter behavior an intervention is aimed at changing [159]. Involving parents in the intervention and understanding the level to which a parent may support or contradict a targeted behavior is imperative to achieving the desired behavior change, in this example, consumption of fruit and vegetables. Another possible explanation for the non-significant change in fruit and vegetable preferences in the present study may be a lack of children's exposure to different types of fruit and vegetables during the intervention. In two previous studies, the use of the school food environment has complemented nutrition education through access to fruits and vegetables in the cafeteria or school gardens [132, 160]. In the "Kids Choice" study, fruit and vegetables were provided to the participants at lunch and in the garden-enhanced study participants planted, harvested, and tasted fruit and vegetables from a school garden. In both studies, fruit and vegetable preferences were increased within the intervention group over time.

Moreover, both interventions lasted significantly longer than the Veggie U intervention (eight weeks and seventeen weeks, respectively). Previous research has shown that 8-10 taste exposures are necessary to produce long lasting increases in preferences [161, 162]. Including access to fruit and vegetables within the school food environment, through school gardens or the cafeteria, could possibly improve the Veggie U curriculum's effectiveness in increasing children's preferences for fruit and vegetables.

Research on the effectiveness of nutrition-education in schools increasing fruit and vegetable preferences and consumption is limited; however, a recent review of 11 studies available was published [163]. In a study conducted by McAleese et al, 2007, results indicated the 12-week garden plus nutrition-education intervention significantly increased fruit and vegetable intake of 6th grade male and female students above the nutrition-education only group and the control group [164]. Morris et al, [160] found similar results. In this garden-enhanced nutrition education curriculum, 4th grade male and female children significantly increased preferences for vegetables grown in the garden (broccoli, snow peas, and zucchini) than the nutrition-education only and control groups at both posttest and at a 6-month follow-up. Nutrition knowledge was also significantly increased in both the garden-enhanced nutrition education group and nutrition-education only group compared to the control group. In a study by Morris et al, 2001, 1st grade male and female children in the intervention group, experienced no significant improvements in fruit and vegetable preferences, however, their willingness to taste vegetables was significantly increased [165]. Lineberger et al, 2000, observed a

significant increase in vegetable preferences but not fruit in 3rd to 5th grade children receiving a 10-lesson garden-enhanced nutrition-education curriculum, however, no change was observed in fruit and vegetable intake over time (pretest to posttest) [166]. Given the results of the previous studies, there is evidence that garden-enhanced nutrition-education may be effective in improving fruit and vegetable preferences and intakes of school-age children; however, further work is needed to optimize these programs and enhance their effectiveness.

Self-efficacy related to fruit and vegetables did not change significantly among children in the intervention group from pretest to posttest in the present study. The lack of change in fruit and vegetable self-efficacy can be explained by the fact that children's self-efficacy to eat fruit and vegetables is directly influenced by parents and other individuals within the child's environment. The potential to increase self-efficacy relies upon an individual's ability to execute a behavior under their control [128]. Children's diets are constrained by the school-food environment and the at-home environment, both of which children have little control over. In addition, self-efficacy to select fruits and vegetables may be limited by availability of such foods, including fruit and vegetable availability data may provide a better understanding of the relationship between self-efficacy and nutrition education. The Veggie U curriculum may have not addressed the issues related to self-efficacy adequately and thus no significant improvements in children's confidence to consume more fruit and vegetables were observed.

The psychosocial variable outcome expectations also showed no significant difference within the intervention group over time (pretest to posttest). This may be because previous research suggests outcome expectations have a greater impact on adult dietary behavior than on children's [128, 153, 154]. A better understanding of how outcome expectations affect dietary behavior specifically among children could provide important insight to future nutrition education curriculum development for child populations. For example, inclusion of the health benefits of fruit and vegetables in the Veggie U curriculum may significantly increase fruit and vegetable outcome expectations among school-aged children.

Limitations to the Study

The findings of this study should be interpreted cautiously. As mentioned earlier, important environmental factors such as, availability of fruit and vegetables at home and in school and parental influences on children's psychosocial characteristics, were not assessed in this study. Additionally, the original design of the study included data collection on fruit and vegetable consumption from all children participating in the study. A total of four 24-hr food recalls were going to be obtained from the children one week before the intervention and three weeks after the intervention (pretest and posttest), along with parental feedback about their children's fruit and vegetable consumption. However, the collection of dietary data from children and parents was not feasible during the study due to time constraints and the science teacher's class schedule. Thus, we explored the

psychosocial variables related to fruit and vegetables without the ability to relate them to children's actual fruit and vegetable consumption. For instance, the lack of fruit and vegetable intake data limits the ability to interpret the effect of increased fruit and vegetable familiarity on fruit and vegetable consumption that was observed from pretest to posttest in the intervention group.

Other major limitations of the present study include the non-randomized design and small sample size. Additionally, the control children were taught, at different times, but in the same classroom as the intervention children. This could have had a contamination effect on the control children, while they did not receive the nutrition lectures they were exposed to the physical components of the Veggie U curriculum such as the worm farm, grow lights, root view boxes, and growing plants. Subsequent studies should attempt to completely separate all aspects of the intervention from the control group.

Implications for Future Research

Future research of this nature needs to be adequate in duration and provide follow-up data to understand how long any changes observed last. The design of a future study should be randomized and include children from a wider diversity of ethnic groups. Additional studies should focus on whether nutrition education curriculums that include access to fruit and vegetables, through either school-gardens, in the school cafeteria, or both can increase fruit and vegetable consumption in school-aged children. Furthermore,

an economic analysis of the sustainability of such education curriculums needs to be evaluated. For example, the Veggie U curriculum costs $300 per classroom. If a school garden were added and access to more fruit and vegetables were provided in the cafeteria these costs would be increased. An understanding of the practicality of implementing such a curriculum throughout the entire school needs to be assessed.

Findings from this study suggest nutrition education curriculums similar to Veggie U can potentially increase fruit and vegetable familiarity in 5th grade students. By implementing a similar nutrition education curriculum educators and other school health officials can have a positive effect on the fruit and vegetable familiarity of 5th grade children. Increasing the number of intervention sessions in the Veggie U curriculum and including the children's parents in the intervention may improve the effectiveness of the intervention at increasing fruit and vegetable knowledge and consumption. Additionally, complementing the Veggie U curriculum with a school-garden and /or increased access to fresh fruit and vegetables in the cafeteria may also enhance the effectiveness of the curriculum. Future studies should examine the relationship between psychosocial variables and fruit and vegetable intakes of the children participating in the study.

The Veggie U curriculum is a great way to introduce children to the importance of eating fruit and vegetables, the science of fruit and vegetables, and the relationship between sustainable agriculture and healthy eating. However, increasing fruit and vegetable consumption in children is much more complex and additional strategies need to be incorporated into the Veggie U curriculum to make a positive impact on the

psychosocial variables associated with increased fruit and vegetable consumption such as parental involvement and improvements to the school-food environment.

REFERENCES

1. Cook S, Weitzman M, Auinger P, Nguyen M, Dietz WH: Prevalence of a metabolic syndrome phenotype in adolescents: findings from the third National Health and Nutrition Examination Survey, 1988-1994. *Arch Pediatr Adolesc Med* 2003, 157(8):821-827.
2. Dietz WH: Health consequences of obesity in youth: childhood predictors of adult disease. *Pediatrics* 1998, 101(3 Pt 2):518-525.
3. Schwartz MB, Puhl R: Childhood obesity: a societal problem to solve. *Obes Rev* 2003, 4(1):57-71.
4. Freedman DS, Dietz WH, Srinivasan SR, Berenson GS: The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa Heart Study. *Pediatrics* 1999, 103(6 Pt 1):1175-1182.
5. Freedman DS, Mei Z, Srinivasan SR, Berenson GS, Dietz WH: Cardiovascular risk factors and excess adiposity among overweight children and adolescents: the Bogalusa Heart Study. *J Pediatr* 2007, 150(1):12-17 e12.
6. Sinaiko AR, Gomez-Marin O, Prineas RJ: Prevalence of "significant" hypertension in junior high school-aged children: the Children and Adolescent Blood Pressure Program. *J Pediatr* 1989, 114(4 Pt 1):664-669.
7. Sorof JM, Lai D, Turner J, Poffenbarger T, Portman RJ: Overweight, ethnicity, and the prevalence of hypertension in school-aged children. *Pediatrics* 2004, 113(3 Pt 1):475-482.
8. Must A, Anderson SE: Effects of obesity on morbidity in children and adolescents. *Nutr Clin Care* 2003, 6(1):4-12.
9. Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH: Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med* 1997, 337(13):869-873.
10. Serdula MK, Ivery D, Coates RJ, Freedman DS, Williamson DF, Byers T: Do obese children become obese adults? A review of the literature. *Prev Med* 1993, 22(2):167-177.
11. Weiss R, Dziura J, Burgert TS, Tamborlane WV, Taksali SE, Yeckel CW, Allen K, Lopes M, Savoye M, Morrison J *et al*: Obesity and the metabolic syndrome in children and adolescents. *N Engl J Med* 2004, 350(23):2362-2374.

12. Weiss R, Taksali SE, Tamborlane WV, Burgert TS, Savoye M, Caprio S: Predictors of changes in glucose tolerance status in obese youth. *Diabetes Care* 2005, 28(4):902-909.
13. Ogden CL, Flegal KM, Carroll MD, Johnson CL: Prevalence and trends in overweight among US children and adolescents, 1999-2000. *JAMA* 2002, 288(14):1728-1732.
14. Flegal KM, Tabak CJ, Ogden CL: Overweight in children: definitions and interpretation. *Health Educ Res* 2006, 21(6):755-760.
15. U.S. Department of Health and Human Services: Office of Disease Prevention and Health Promotion--Healthy People 2010. *Nasnewsletter* 2000, 15(3):3.
16. Ogden CL, Carroll MD, Flegal KM: High body mass index for age among US children and adolescents, 2003-2006. *JAMA* 2008, 299(20):2401-2405.
17. Wang G, Dietz WH: Economic burden of obesity in youths aged 6 to 17 years: 1979-1999. *Pediatrics* 2002, 109(5):E81-81.
18. Farooqi IS, O'Rahilly S: Recent advances in the genetics of severe childhood obesity. *Arch Dis Child* 2000, 83(1):31-34.
19. Le Stunff C, Fallin D, Bougneres P: Paternal transmission of the very common class I INS VNTR alleles predisposes to childhood obesity. *Nat Genet* 2001, 29(1):96-99.
20. Nielsen SJ, Siega-Riz AM, Popkin BM: Trends in energy intake in U.S. between 1977 and 1996: similar shifts seen across age groups. *Obes Res* 2002, 10(5):370-378.
21. McConahy KL, Smiciklas-Wright H, Birch LL, Mitchell DC, Picciano MF: Food portions are positively related to energy intake and body weight in early childhood. *J Pediatr* 2002, 140(3):340-347.
22. Rolls BJ, Roe LS, Meengs JS, Wall DE: Increasing the portion size of a sandwich increases energy intake. *J Am Diet Assoc* 2004, 104(3):367-372.
23. Rolls BJ, Roe LS, Kral TV, Meengs JS, Wall DE: Increasing the portion size of a packaged snack increases energy intake in men and women. *Appetite* 2004, 42(1):63-69.
24. Diliberti N, Bordi PL, Conklin MT, Roe LS, Rolls BJ: Increased portion size leads to increased energy intake in a restaurant meal. *Obes Res* 2004, 12(3):562-568.
25. Ledikwe JH, Ello-Martin JA, Rolls BJ: Portion sizes and the obesity epidemic. *J Nutr* 2005, 135(4):905-909.
26. Young LR, Nestle M: The contribution of expanding portion sizes to the US obesity epidemic. *Am J Public Health* 2002, 92(2):246-249.
27. Young LR, Nestle M: Expanding portion sizes in the US marketplace: implications for nutrition counseling. *J Am Diet Assoc* 2003, 103(2):231-234.
28. Smiciklas-Wright H, Mitchell DC, Mickle SJ, Goldman JD, Cook A: Foods commonly eaten in the United States, 1989-1991 and 1994-1996: are portion sizes

changing? *J Am Diet Assoc* 2003, 103(1):41-47.
29. Nielsen SJ, Popkin BM: Patterns and trends in food portion sizes, 1977-1998. *JAMA* 2003, 289(4):450-453.
30. Gidding SS, Bao W, Srinivasan SR, Berenson GS: Effects of secular trends in obesity on coronary risk factors in children: the Bogalusa Heart Study. *J Pediatr* 1995, 127(6):868-874.
31. Dietz WH, Jr., Gortmaker SL: Do we fatten our children at the television set? Obesity and television viewing in children and adolescents. *Pediatrics* 1985, 75(5):807-812.
32. Gortmaker SL, Must A, Sobol AM, Peterson K, Colditz GA, Dietz WH: Television viewing as a cause of increasing obesity among children in the United States, 1986-1990. *Arch Pediatr Adolesc Med* 1996, 150(4):356-362.
33. Crespo CJ, Smit E, Troiano RP, Bartlett SJ, Macera CA, Andersen RE: Television watching, energy intake, and obesity in US children: results from the third National Health and Nutrition Examination Survey, 1988-1994. *Arch Pediatr Adolesc Med* 2001, 155(3):360-365.
34. Cohen JH, Kristal AR, Stanford JL: Fruit and vegetable intakes and prostate cancer risk. *J Natl Cancer Inst* 2000, 92(1):61-68.
35. Liu S, Manson JE, Lee IM, Cole SR, Hennekens CH, Willett WC, Buring JE: Fruit and vegetable intake and risk of cardiovascular disease: the Women's Health Study. *Am J Clin Nutr* 2000, 72(4):922-928.
36. Michaud DS, Feskanich D, Rimm EB, Colditz GA, Speizer FE, Willett WC, Giovannucci E: Intake of specific carotenoids and risk of lung cancer in 2 prospective US cohorts. *Am J Clin Nutr* 2000, 72(4):990-997.
37. Joshipura KJ, Hu FB, Manson JE, Stampfer MJ, Rimm EB, Speizer FE, Colditz G, Ascherio A, Rosner B, Spiegelman D *et al*: The effect of fruit and vegetable intake on risk for coronary heart disease. *Ann Intern Med* 2001, 134(12):1106-1114.
38. Story M, Neumark-Sztainer D, French S: Individual and environmental influences on adolescent eating behaviors. *J Am Diet Assoc* 2002, 102(3 Suppl):S40-51.
39. Leahy KE, Birch LL, Rolls BJ: Reducing the energy density of an entree decreases children's energy intake at lunch. *J Am Diet Assoc* 2008, 108(1):41-48.
40. Leahy KE, Birch LL, Rolls BJ: Reducing the energy density of multiple meals decreases the energy intake of preschool-age children. *Am J Clin Nutr* 2008, 88(6):1459-1468.
41. Mei Z, Grummer-Strawn LM, Pietrobelli A, Goulding A, Goran MI, Dietz WH: Validity of body mass index compared with other body-composition screening indexes for the assessment of body fatness in children and adolescents. *Am J Clin Nutr* 2002, 75(6):978-985.
42. Barlow SE: Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity:

summary report. *Pediatrics* 2007, 120 Suppl 4:S164-192.
43. Spiotta RT, Luma GB: Evaluating obesity and cardiovascular risk factors in children and adolescents. *Am Fam Physician* 2008, 78(9):1052-1058.
44. Stabouli S, Kotsis V, Papamichael C, Constantopoulos A, Zakopoulos N: Adolescent obesity is associated with high ambulatory blood pressure and increased carotid intimal-medial thickness. *J Pediatr* 2005, 147(5):651-656.
45. Muntner P, He J, Cutler JA, Wildman RP, Whelton PK: Trends in blood pressure among children and adolescents. *JAMA* 2004, 291(17):2107-2113.
46. Lauer RM, Clarke WR: Childhood risk factors for high adult blood pressure: the Muscatine Study. *Pediatrics* 1989, 84(4):633-641.
47. Alberti KG, Zimmet P, Shaw J: The metabolic syndrome--a new worldwide definition. *Lancet* 2005, 366(9491):1059-1062.
48. Weiss R, Kaufman FR: Metabolic complications of childhood obesity: identifying and mitigating the risk. *Diabetes Care* 2008, 31 Suppl 2:S310-316.
49. Patel AV, Feigelson HS, Talbot JT, McCullough ML, Rodriguez C, Patel RC, Thun MJ, Calle EE: The role of body weight in the relationship between physical activity and endometrial cancer: results from a large cohort of US women. *International Journal Of Cancer Journal International Du Cancer* 2008, 123(8):1877-1882.
50. Calle EE, Rodriguez C, Walker-Thurmond K, Thun MJ: Overweight, obesity, and mortality from cancer in a prospectively studied cohort of U.S. adults. *N Engl J Med* 2003, 348(17):1625-1638.
51. Mahoney MC, Bevers T, Linos E, Willett WC: Opportunities and strategies for breast cancer prevention through risk reduction. *CA: A Cancer Journal For Clinicians* 2008, 58(6):347-371.
52. Rafiq N, Younossi ZM: Effects of weight loss on nonalcoholic fatty liver disease. *Seminars In Liver Disease* 2008, 28(4):427-433.
53. Dittrick GW, Thompson JS, Campos D, Bremers D, Sudan D: Gallbladder pathology in morbid obesity. *Obes Surg* 2005, 15(2):238-242.
54. Pender JR, Pories WJ: Epidemiology of obesity in the United States. *Gastroenterology Clinics Of North America* 2005, 34(1):1-7.
55. Gelber AC, Hochberg MC, Mead LA, Wang NY, Wigley FM, Klag MJ: Body mass index in young men and the risk of subsequent knee and hip osteoarthritis. *The American Journal Of Medicine* 1999, 107(6):542-548.
56. Norman RJ, Dewailly D, Legro RS, Hickey TE: Polycystic ovary syndrome. *Lancet* 2007, 370(9588):685-697.
57. Freedman DS, Khan LK, Dietz WH, Srinivasan SR, Berenson GS: Relationship of childhood obesity to coronary heart disease risk factors in adulthood: the Bogalusa Heart Study. *Pediatrics* 2001, 108(3):712-718.
58. Koplan JP, Liverman CT, Kraak VI: Preventing childhood obesity: health in the balance: executive summary. *J Am Diet Assoc* 2005, 105(1):131-138.

59. Johnson RK: Dietary intake--how do we measure what people are really eating? *Obes Res* 2002, 10 Suppl 1:63S-68S.
60. Blakemore AI, Froguel P: Is obesity our genetic legacy? *J Clin Endocrinol Metab* 2008, 93(11 Suppl 1):S51-56.
61. Nielsen SJ, Popkin BM: Changes in beverage intake between 1977 and 2001. *Am J Prev Med* 2004, 27(3):205-210.
62. Crawford PB, Woodward-Lopez G, Ritchie L, Webb K: How discretionary can we be with sweetened beverages for children? *J Am Diet Assoc* 2008, 108(9):1440-1444.
63. Rolls BJ, Engell D, Birch LL: Serving portion size influences 5-year-old but not 3-year-old children's food intakes. *J Am Diet Assoc* 2000, 100(2):232-234.
64. Rolls BJ, Morris EL, Roe LS: Portion size of food affects energy intake in normal-weight and overweight men and women. *Am J Clin Nutr* 2002, 76(6):1207-1213.
65. Orlet Fisher J, Rolls BJ, Birch LL: Children's bite size and intake of an entree are greater with large portions than with age-appropriate or self-selected portions. *Am J Clin Nutr* 2003, 77(5):1164-1170.
66. Guenther PM, Dodd KW, Reedy J, Krebs-Smith SM: Most Americans eat much less than recommended amounts of fruits and vegetables. *J Am Diet Assoc* 2006, 106(9):1371-1379.
67. Eaton DK, Kann L, Kinchen S, Ross J, Hawkins J, Harris WA, Lowry R, McManus T, Chyen D, Shanklin S *et al*: Youth risk behavior surveillance--United States, 2005. *MMWR Surveill Summ* 2006, 55(5):1-108.
68. Participation in high school physical education--United States, 1991-2003. *MMWR Morb Mortal Wkly Rep* 2004, 53(36):844-847.
69. Strong WB, Malina RM, Blimkie CJ, Daniels SR, Dishman RK, Gutin B, Hergenroeder AC, Must A, Nixon PA, Pivarnik JM *et al*: Evidence based physical activity for school-age youth. *J Pediatr* 2005, 146(6):732-737.
70. Malina RM: Tracking of physical activity and physical fitness across the lifespan. *Res Q Exerc Sport* 1996, 67(3 Suppl):S48-57.
71. Must A, Tybor DJ: Physical activity and sedentary behavior: a review of longitudinal studies of weight and adiposity in youth. *Int J Obes (Lond)* 2005, 29 Suppl 2:S84-96.
72. Andersen RE, Crespo CJ, Bartlett SJ, Cheskin LJ, Pratt M: Relationship of physical activity and television watching with body weight and level of fatness among children: results from the Third National Health and Nutrition Examination Survey. *JAMA* 1998, 279(12):938-942.
73. Lowry R, Wechsler H, Galuska DA, Fulton JE, Kann L: Television viewing and its associations with overweight, sedentary lifestyle, and insufficient consumption of fruits and vegetables among US high school students: differences by race, ethnicity, and gender. *J Sch Health* 2002, 72(10):413-421.

74. Robinson TN, Hammer LD, Killen JD, Kraemer HC, Wilson DM, Hayward C, Taylor CB: Does television viewing increase obesity and reduce physical activity? Cross-sectional and longitudinal analyses among adolescent girls. *Pediatrics* 1993, 91(2):273-280.
75. Coon KA, Tucker KL: Television and children's consumption patterns. A review of the literature. *Minerva Pediatr* 2002, 54(5):423-436.
76. Francis LA, Birch LL: Does eating during television viewing affect preschool children's intake? *J Am Diet Assoc* 2006, 106(4):598-600.
77. Treuth MS, Butte NF, Wong WW: Effects of familial predisposition to obesity on energy expenditure in multiethnic prepubertal girls. *Am J Clin Nutr* 2000, 71(4):893-900.
78. Morland K, Wing S, Diez Roux A, Poole C: Neighborhood characteristics associated with the location of food stores and food service places. *Am J Prev Med* 2002, 22(1):23-29.
79. Hung HC, Joshipura KJ, Jiang R, Hu FB, Hunter D, Smith-Warner SA, Colditz GA, Rosner B, Spiegelman D, Willett WC: Fruit and vegetable intake and risk of major chronic disease. *J Natl Cancer Inst* 2004, 96(21):1577-1584.
80. Gaziano JM, Manson JE, Branch LG, Colditz GA, Willett WC, Buring JE: A prospective study of consumption of carotenoids in fruits and vegetables and decreased cardiovascular mortality in the elderly. *Ann Epidemiol* 1995, 5(4):255-260.
81. Ness AR, Powles JW: Fruit and vegetables, and cardiovascular disease: a review. *Int J Epidemiol* 1997, 26(1):1-13.
82. Joshipura KJ, Ascherio A, Manson JE, Stampfer MJ, Rimm EB, Speizer FE, Hennekens CH, Spiegelman D, Willett WC: Fruit and vegetable intake in relation to risk of ischemic stroke. *JAMA* 1999, 282(13):1233-1239.
83. Terry P, Giovannucci E, Michels KB, Bergkvist L, Hansen H, Holmberg L, Wolk A: Fruit, vegetables, dietary fiber, and risk of colorectal cancer. *J Natl Cancer Inst* 2001, 93(7):525-533.
84. Chan JM, Giovannucci EL: Vegetables, fruits, associated micronutrients, and risk of prostate cancer. *Epidemiol Rev* 2001, 23(1):82-86.
85. Feskanich D, Ziegler RG, Michaud DS, Giovannucci EL, Speizer FE, Willett WC, Colditz GA: Prospective study of fruit and vegetable consumption and risk of lung cancer among men and women. *J Natl Cancer Inst* 2000, 92(22):1812-1823.
86. Block G, Patterson B, Subar A: Fruit, vegetables, and cancer prevention: a review of the epidemiological evidence. *Nutr Cancer* 1992, 18(1):1-29.
87. Steinmetz KA, Potter JD: Vegetables, fruit, and cancer. I. Epidemiology. *Cancer Causes Control* 1991, 2(5):325-357.
88. Frei B: Reactive oxygen species and antioxidant vitamins: mechanisms of action. *Am J Med* 1994, 97(3A):5S-13S; discussion 22S-28S.

89. Meydani SN, Wu D, Santos MS, Hayek MG: Antioxidants and immune response in aged persons: overview of present evidence. *Am J Clin Nutr* 1995, 62(6 Suppl):1462S-1476S.
90. Blount BC, Mack MM, Wehr CM, MacGregor JT, Hiatt RA, Wang G, Wickramasinghe SN, Everson RB, Ames BN: Folate deficiency causes uracil misincorporation into human DNA and chromosome breakage: implications for cancer and neuronal damage. *Proc Natl Acad Sci U S A* 1997, 94(7):3290-3295.
91. Rolls BJ, Ello-Martin JA, Tohill BC: What can intervention studies tell us about the relationship between fruit and vegetable consumption and weight management? *Nutr Rev* 2004, 62(1):1-17.
92. Ledikwe JH, Blanck HM, Kettel Khan L, Serdula MK, Seymour JD, Tohill BC, Rolls BJ: Dietary energy density is associated with energy intake and weight status in US adults. *Am J Clin Nutr* 2006, 83(6):1362-1368.
93. Grunwald GK, Seagle HM, Peters JC, Hill JO: Quantifying and separating the effects of macronutrient composition and non-macronutrients on energy density. *Br J Nutr* 2001, 86(2):265-276.
94. Diet, nutrition and the prevention of chronic diseases. *World Health Organ Tech Rep Ser* 2003, 916:i-viii, 1-149, backcover.
95. Bell EA, Rolls BJ: Energy density of foods affects energy intake across multiple levels of fat content in lean and obese women. *Am J Clin Nutr* 2001, 73(6):1010-1018.
96. Rolls BJ, Bell EA, Castellanos VH, Chow M, Pelkman CL, Thorwart ML: Energy density but not fat content of foods affected energy intake in lean and obese women. *Am J Clin Nutr* 1999, 69(5):863-871.
97. Stubbs RJ, Harbron CG, Murgatroyd PR, Prentice AM: Covert manipulation of dietary fat and energy density: effect on substrate flux and food intake in men eating ad libitum. *Am J Clin Nutr* 1995, 62(2):316-329.
98. Bell EA, Castellanos VH, Pelkman CL, Thorwart ML, Rolls BJ: Energy density of foods affects energy intake in normal-weight women. *Am J Clin Nutr* 1998, 67(3):412-420.
99. Kral TV, Roe LS, Rolls BJ: Combined effects of energy density and portion size on energy intake in women. *Am J Clin Nutr* 2004, 79(6):962-968.
100. Rolls BJ, Roe LS, Beach AM, Kris-Etherton PM: Provision of foods differing in energy density affects long-term weight loss. *Obes Res* 2005, 13(6):1052-1060.
101. Epstein LH, Gordy CC, Raynor HA, Beddome M, Kilanowski CK, Paluch R: Increasing fruit and vegetable intake and decreasing fat and sugar intake in families at risk for childhood obesity. *Obes Res* 2001, 9(3):171-178.
102. Rolls BJ, Bell EA, Thorwart ML: Water incorporated into a food but not served with a food decreases energy intake in lean women. *Am J Clin Nutr* 1999, 70(4):448-455.
103. Duncan KH, Bacon JA, Weinsier RL: The effects of high and low energy density

diets on satiety, energy intake, and eating time of obese and nonobese subjects. *Am J Clin Nutr* 1983, 37(5):763-767.
104. Rolls BJ, Bell EA, Waugh BA: Increasing the volume of a food by incorporating air affects satiety in men. *Am J Clin Nutr* 2000, 72(2):361-368.
105. Yao M, Roberts SB: Dietary energy density and weight regulation. *Nutr Rev* 2001, 59(8 Pt 1):247-258.
106. Haber GB, Heaton KW, Murphy D, Burroughs LF: Depletion and disruption of dietary fibre. Effects on satiety, plasma-glucose, and serum-insulin. *Lancet* 1977, 2(8040):679-682.
107. Bolton RP, Heaton KW, Burroughs LF: The role of dietary fiber in satiety, glucose, and insulin: studies with fruit and fruit juice. *Am J Clin Nutr* 1981, 34(2):211-217.
108. Gustafsson K, Asp NG, Hagander B, Nyman M: Satiety effects of spinach in mixed meals: comparison with other vegetables. *Int J Food Sci Nutr* 1995, 46(4):327-334.
109. Gustafsson K, Asp NG, Hagander B, Nyman M, Schweizer T: Influence of processing and cooking of carrots in mixed meals on satiety, glucose and hormonal response. *Int J Food Sci Nutr* 1995, 46(1):3-12.
110. Gustafsson K, Asp NG, Hagander B, Nyman M: Dose-response effects of boiled carrots and effects of carrots in lactic acid in mixed meals on glycaemic response and satiety. *Eur J Clin Nutr* 1994, 48(6):386-396.
111. Gustafsson K, Asp NG, Hagander B, Nyman M: Effects of different vegetables in mixed meals on glucose homeostasis and satiety. *Eur J Clin Nutr* 1993, 47(3):192-200.
112. Howarth NC, Saltzman E, Roberts SB: Dietary fiber and weight regulation. *Nutr Rev* 2001, 59(5):129-139.
113. Dolecek TA, Stamler J, Caggiula AW, Tillotson JL, Buzzard IM: Methods of dietary and nutritional assessment and intervention and other methods in the Multiple Risk Factor Intervention Trial. *Am J Clin Nutr* 1997, 65(1 Suppl):196S-210S.
114. Fitzwater SL, Weinsier RL, Wooldridge NH, Birch R, Liu C, Bartolucci AA: Evaluation of long-term weight changes after a multidisciplinary weight control program. *J Am Diet Assoc* 1991, 91(4):421-426, 429.
115. Rock CL, Thomson C, Caan BJ, Flatt SW, Newman V, Ritenbaugh C, Marshall JR, Hollenbach KA, Stefanick ML, Pierce JP: Reduction in fat intake is not associated with weight loss in most women after breast cancer diagnosis: evidence from a randomized controlled trial. *Cancer* 2001, 91(1):25-34.
116. Singh RB, Rastogi SS, Verma R, Laxmi B, Singh R, Ghosh S, Niaz MA: Randomised controlled trial of cardioprotective diet in patients with recent acute myocardial infarction: results of one year follow up. *BMJ* 1992, 304(6833):1015-1019.

117. Singh RB, Rastogi SS, Niaz MA, Ghosh S, Singh R, Gupta S: Effect of fat-modified and fruit- and vegetable-enriched diets on blood lipids in the Indian Diet Heart Study. *Am J Cardiol* 1992, 70(9):869-874.
118. Singh RB, Dubnov G, Niaz MA, Ghosh S, Singh R, Rastogi SS, Manor O, Pella D, Berry EM: Effect of an Indo-Mediterranean diet on progression of coronary artery disease in high risk patients (Indo-Mediterranean Diet Heart Study): a randomised single-blind trial. *Lancet* 2002, 360(9344):1455-1461.
119. Serdula MK, Byers T, Mokdad AH, Simoes E, Mendlein JM, Coates RJ: The association between fruit and vegetable intake and chronic disease risk factors. *Epidemiology* 1996, 7(2):161-165.
120. Lin BH: Higher fruit consumption linked with lower body mass index. *Food Review* 2002, 25:28-32.
121. Kahn HS, Tatham LM, Rodriguez C, Calle EE, Thun MJ, Heath CW, Jr.: Stable behaviors associated with adults' 10-year change in body mass index and likelihood of gain at the waist. *Am J Public Health* 1997, 87(5):747-754.
122. Cooke LJ, Wardle J, Gibson EL, Sapochnik M, Sheiham A, Lawson M: Demographic, familial and trait predictors of fruit and vegetable consumption by pre-school children. *Public Health Nutr* 2004, 7(2):295-302.
123. Skinner JD, Carruth BR, Bounds W, Ziegler P, Reidy K: Do food-related experiences in the first 2 years of life predict dietary variety in school-aged children? *J Nutr Educ Behav* 2002, 34(6):310-315.
124. Zabinski MF, Daly T, Norman GJ, Rupp JW, Calfas KJ, Sallis JF, Patrick K: Psychosocial correlates of fruit, vegetable, and dietary fat intake among adolescent boys and girls. *J Am Diet Assoc* 2006, 106(6):814-821.
125. Woodward DR, Boon JA, Cumming FJ, Ball PJ, Williams HM, Hornsby H: Adolescents' reported usage of selected foods in relation to their perceptions and social norms for those foods. *Appetite* 1996, 27(2):109-117.
126. Baranowski T, Davis M, Resnicow K, Baranowski J, Doyle C, Lin LS, Smith M, Wang DT: Gimme 5 fruit, juice, and vegetables for fun and health: outcome evaluation. *Health Educ Behav* 2000, 27(1):96-111.
127. Cullen KW, Eagan J, Baranowski T, Owens E, de Moor C: Effect of a la carte and snack bar foods at school on children's lunchtime intake of fruits and vegetables. *J Am Diet Assoc* 2000, 100(12):1482-1486.
128. Resnicow K, Davis-Hearn M, Smith M, Baranowski T, Lin LS, Baranowski J, Doyle C, Wang DT: Social-cognitive predictors of fruit and vegetable intake in children. *Health Psychol* 1997, 16(3):272-276.
129. Calfas KJ, Sallis JF, Nader PR: The development of scales to measure knowledge and preference for diet and physical activity behavior in 4- to 8-year-old children. *J Dev Behav Pediatr* 1991, 12(3):185-190.
130. Parcel GS, Simons-Morton B, O'Hara NM, Baranowski T, Wilson B: School promotion of healthful diet and physical activity: impact on learning outcomes

and self-reported behavior. *Health Educ Q* 1989, 16(2):181-199.
131. Gallaway MS, Jago R, Baranowski T, Baranowski JC, Diamond PM: Psychosocial and demographic predictors of fruit, juice and vegetable consumption among 11-14-year-old Boy Scouts. *Public Health Nutr* 2007, 10(12):1508-1514.
132. Hendy HM, Williams KE, Camise TS: "Kids Choice" school lunch program increases children's fruit and vegetable acceptance. *Appetite* 2005, 45(3):250-263.
133. Haire-Joshu D, Kreuter MK, Holt C, Steger-May K: Estimates of fruit and vegetable intake in childhood and adult dietary behaviors of African American women. *J Nutr Educ Behav* 2004, 36(6):309-314.
134. Domel SB, Baranowski T, Davis HC, Thompson WO, Leonard SB, Baranowski J: A measure of stages of change in fruit and vegetable consumption among fourth- and fifth-grade school children: reliability and validity. *J Am Coll Nutr* 1996, 15(1):56-64.
135. Perez-Rodrigo C, Ribas L, Serra-Majem L, Aranceta J: Food preferences of Spanish children and young people: the enKid study. *Eur J Clin Nutr* 2003, 57 Suppl 1:S45-48.
136. Vereecken CA, Van Damme W, Maes L: Measuring attitudes, self-efficacy, and social and environmental influences on fruit and vegetable consumption of 11- and 12-year-old children: reliability and validity. *J Am Diet Assoc* 2005, 105(2):257-261.
137. Reynolds KD, Baranowski T, Bishop DB, Farris RP, Binkley D, Nicklas TA, Elmer PJ: Patterns in child and adolescent consumption of fruit and vegetables: effects of gender and ethnicity across four sites. *J Am Coll Nutr* 1999, 18(3):248-254.
138. Cullen KW, Baranowski T, Owens E, Marsh T, Rittenberry L, de Moor C: Availability, accessibility, and preferences for fruit, 100% fruit juice, and vegetables influence children's dietary behavior. *Health Educ Behav* 2003, 30(5):615-626.
139. Wind M, de Bourdeaudhuij I, te Velde SJ, Sandvik C, Due P, Klepp KI, Brug J: Correlates of fruit and vegetable consumption among 11-year-old Belgian-Flemish and Dutch schoolchildren. *J Nutr Educ Behav* 2006, 38(4):211-221.
140. Bere E, Klepp KI: Correlates of fruit and vegetable intake among Norwegian schoolchildren: parental and self-reports. *Public Health Nutr* 2004, 7(8):991-998.
141. Warren JM, Henry CJ, Lightowler HJ, Bradshaw SM, Perwaiz S: Evaluation of a pilot school programme aimed at the prevention of obesity in children. *Health Promotion International* 2003, 18(4):287-296.
142. Van Duyn MA, Kristal AR, Dodd K, Campbell MK, Subar AF, Stables G, Nebeling L, Glanz K: Association of awareness, intrapersonal and interpersonal factors, and stage of dietary change with fruit and vegetable consumption: a national survey. *Am J Health Promot* 2001, 16(2):69-78.

143. Krebs-Smith SM, Heimendinger J, Patterson BH, Subar AF, Kessler R, Pivonka E: Psychosocial factors associated with fruit and vegetable consumption. *Am J Health Promot* 1995, 10(2):98-104.
144. Brug J, Tak NI, te Velde SJ, Bere E, de Bourdeaudhuij I: Taste preferences, liking and other factors related to fruit and vegetable intakes among schoolchildren: results from observational studies. *The British Journal Of Nutrition* 2008, 99 Suppl 1:S7-s14.
145. Brug J, Lechner L, De Vries H: Psychosocial determinants of fruit and vegetable consumption. *Appetite* 1995, 25(3):285-296.
146. Cullen KW, Bartholomew LK, Parcel GS, Koehly L: Measuring stage of change for fruit and vegetable consumption in 9- to 12-year-old girls. *J Behav Med* 1998, 21(3):241-254.
147. Granner ML, Sargent RG, Calderon KS, Hussey JR, Evans AE, Watkins KW: Factors of fruit and vegetable intake by race, gender, and age among young adolescents. *J Nutr Educ Behav* 2004, 36(4):173-180.
148. Martens MK, van Assema P, Brug J: Why do adolescents eat what they eat? Personal and social environmental predictors of fruit, snack and breakfast consumption among 12-14-year-old Dutch students. *Public Health Nutr* 2005, 8(8):1258-1265.
149. Sandvik C, De Bourdeaudhuij I, Due P, Brug J, Wind M, Bere E, Perez-Rodrigo C, Wolf A, Elmadfa I, Thorsdottir I *et al*: Personal, social and environmental factors regarding fruit and vegetable intake among schoolchildren in nine European countries. *Ann Nutr Metab* 2005, 49(4):255-266.
150. Havas S, Treiman K, Langenberg P, Ballesteros M, Anliker J, Damron D, Feldman R: Factors associated with fruit and vegetable consumption among women participating in WIC. *J Am Diet Assoc* 1998, 98(10):1141-1148.
151. De Bourdeaudhuij I, te Velde S, Brug J, Due P, Wind M, Sandvik C, Maes L, Wolf A, Perez Rodrigo C, Yngve A *et al*: Personal, social and environmental predictors of daily fruit and vegetable intake in 11-year-old children in nine European countries. *European Journal Of Clinical Nutrition* 2008, 62(7):834-841.
152. Rosenstock IM, Strecher VJ, Becker MH: Social learning theory and the Health Belief Model. *Health Educ Q* 1988, 15(2):175-183.
153. Satia JA, Kristal AR, Patterson RE, Neuhouser ML, Trudeau E: Psychosocial factors and dietary habits associated with vegetable consumption. *Nutrition* 2002, 18(3):247-254.
154. Trudeau E, Kristal AR, Li S, Patterson RE: Demographic and psychosocial predictors of fruit and vegetable intakes differ: implications for dietary interventions. *J Am Diet Assoc* 1998, 98(12):1412-1417.
155. Reynolds KD, Yaroch AL, Franklin FA, Maloy J: Testing mediating variables in a school-based nutrition intervention program. *Health Psychol* 2002, 21(1):51-60.
156. Lytle LA: Nutrition Education for School-Aged Children: A Review of Research.

In. Edited by U.S. Department of Agriculture FaCS, Office of Analysis and Evaluation. Alexandria, VA: U.S. Department of Agriculture, Food and Consumer Service, Office of Analysis and Evaluation, 3101 Park Center Drive, Alexandria, VA 22302.; 1994.
157. Connell DB, Turner RR, Mason EF: Summary of findings of the School Health Education Evaluation: health promotion effectiveness, implementation, and costs. *J Sch Health* 1985, 55(8):316-321.
158. Resnicow K, Cohn L, Reinhardt J, Cross D, Futterman R, Kirschner E, Wynder EL, Allegrante JP: A three-year evaluation of the know your body program in inner-city schoolchildren. *Health Educ Q* 1992, 19(4):463-480.
159. Epstein LH: Family-based behavioural intervention for obese children. *Int J Obes Relat Metab Disord* 1996, 20 Suppl 1:S14-21.
160. Morris JL, Zidenberg-Cherr S: Garden-enhanced nutrition curriculum improves fourth-grade school children's knowledge of nutrition and preferences for some vegetables. *J Am Diet Assoc* 2002, 102(1):91-93.
161. Birch LL, McPhee L, Shoba BC, Pirok E, Steinberg L: What kind of exposure reduces children's food neophobia? Looking vs. tasting. *Appetite* 1987, 9(3):171-178.
162. Birch LL, Marlin DW: I don't like it; I never tried it: effects of exposure on two-year-old children's food preferences. *Appetite* 1982, 3(4):353-360.
163. Robinson-O'Brien R, Story M, Heim S: Impact of garden-based youth nutrition intervention programs: a review. *J Am Diet Assoc* 2009, 109(2):273-280.
164. McAleese JD, Rankin LL: Garden-based nutrition education affects fruit and vegetable consumption in sixth-grade adolescents. *J Am Diet Assoc* 2007, 107(4):662-665.
165. Morris J NA, Zidenberg-Cherr S.: First-grade gardeners more likely to taste vegetables. *California Agriculture* 2001:43-46.
166. Lineberger S, Zajicek, J., : School gardens: Can a hands-on teaching tool affect students' attitudes and behaviors regarding fruit and vegetables? *Horticulture Technology* 2000, 10:593-597.

APPENDICES

Oklahoma State University Institutional Review Board

Date:	Monday, September 08, 2008
IRB Application	HE0841
Proposal Title:	Does the "Veggie U" Curriculum Increase Nutritional Knowledge and Intake of Fruits and Vegetables in 4th Grade Children?
Reviewed and Processed as:	Expedited (Spec Pop)

Status Recommended by Reviewer(s): **Protocol Expires: 9/7/2009**

Principal Investigator(s):

Ryan Fiddler
2415 N. Star Dr.
Stillwater, OK 74075

Lenka Humenikova Shriver
311 HES
Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Beth McTernan in 219 Cordell North (phone: 405-744-5700, beth.mcternan@okstate.edu).

Sincerely,

Shelia Kennison, Chair
Institutional Review Board

Appendix B

Approval from Richmond Elementary School Principal for Research Project

This research project is being conducted by Ryan Fiddler, an M.S. student in the Department of Nutritional Sciences at Oklahoma State University. The purpose of this study will be to investigate the efficacy of the Veggie U "Earth to Table" science curriculum at increasing fruit and vegetable knowledge, preferences, outcome expectations, self-efficacy, and increasing fruit and vegetable intake of 5th grade school-aged children. The results of this study will help identify effective means of increasing fruit and vegetable intake of school-aged children. Currently, less than 15% of school-aged children consume the recommended 5 daily servings of fruits and vegetables. The results of this study will also help design more effective interventions to improve nutrition status among school-aged children in the U.S.

During the study, parents will be asked to complete a questionnaire that includes questions related to their child's daily intake of fruits and vegetables. Similar information from children will be collected during regular school time. Children will be asked to complete a four 24-hour food recalls on two separate occasions, once before the implementation of the Veggie-U curriculum and once again upon completion of the Veggie-U curriculum.

The participation in the study is voluntary.

All information collected from parents and children will be kept confidential. No one will be able to connect parents' or children's names with the collected data. Both parents and children will be assigned ID numbers which will serve as the only way for identifying subjects during the study. All names and other personal information will be kept in a locked file cabinet and only the primary investigator will have access to this information.

This study has been reviewed and approved by the Oklahoma State University Institutional Review Board (IRB). If you have questions about the nature of the study you may contact Dr. Sheila Kennison, IRB Chair, 219 Cordell North, Stillwater, OK 74078, 405-744-1676 or irb@okstate.edu

I have read and I fully understand this form. I sign my name freely and voluntarily. A copy of this form was given to me.

_____ Date: _____

Richmond Elementary Principal

Appendix C: Teacher Confidentiality Agreement

During the course of the Veggie-U "Earth to Table" science curriculum and the supporting questionnaires it is necessary to protect the confidentiality of all subjects (parents and children) involved in the study. Therefore, it will be necessary for both the primary investigator, Ryan Fiddler, and the science teacher, Deedee Leibenau, to keep all data and any other information obtained from the subjects confidential.

If you agree to the above terms, please sign below.

_____ Date: _____
Science Teacher

Appendix D
INFORMED CONSENT FOR PARTICIPATION IN THE STUDY

This research project is being conducted by Ryan Fiddler, an M.S. student in the Department of Nutritional Sciences at Oklahoma State University. The purpose of this study will be to investigate the efficacy of the Veggie U "Earth to Table" science curriculum at increasing fruit and vegetable knowledge, preferences, outcome expectations, self-efficacy, and increasing fruit and vegetable intake of 5th grade school-aged children. The results of this study will help identify effective means of increasing fruit and vegetable intake of school-aged children. Currently, less than 15% of school-aged children consume the recommended 5 daily servings of fruits and vegetables. The results of this study will also help design more effective interventions to improve nutrition status among school-aged children in the U.S.

During the study, parents will be asked to complete a questionnaire that includes questions related to their child's daily intake of fruits and vegetables. The completion of the questionnaire will take approximately 15-20 minutes. Similar information from children will be collected during regular school time. Children will be asked to complete four 24-hour food recalls on two separate occasions, once before the implementation of the Veggie-U curriculum and once again upon completion of the Veggie-U curriculum. There is no risk in participating in this study for you and your child.

The participation in the study is voluntary. If your child feels uncomfortable while reporting any information, he/she can choose not to answer any question, or to withdraw completely from the study at any time. You also have the right to withdraw the consent for either yourself or your child at any time by notifying the child's teacher. There is no penalty for refusal to participate. You and/or your child can ask questions to the primary investigator, Ryan Fiddler, at any time or contact him by telephone at 918-633-3578 or email him at ryan.fiddler@okstate.edu.

All information collected from parents and children will be kept confidential. No one will be able to connect parents' or children's names with the collected data. Both parents and children will be assigned ID numbers which will serve as the only way for identifying subjects during the study. All names and other personal information will be kept in a locked file cabinet and only the primary investigator will have access to this information. Upon completion of data collection names will be discarded and only ID numbers will serve as identifiers. It is possible that the assent process and data collection will be observed by research oversight staff responsible for safeguarding the rights and wellbeing of people who participate in research.

This study has been reviewed and approved by the Oklahoma State University Institutional Review Board (IRB). If you have questions about your rights as a research volunteer, you may contact Dr. Sheila Kennison, IRB Chair, 219 Cordell North, Stillwater, OK 74078, 405-744-1676 or irb@okstate.edu

I have read and I fully understand this informed consent form. The primary investigator, Ryan Fiddler, has fully explained the study and I agree to participate in this study. I also give consent for my child. I sign my name freely and voluntarily. A copy of this informed consent form was given to me.

_____ _____ Date:___

Parent Signature Child's Name (Print Clearly)

I certify that I have personally given the full description of the study and I have explained the nature of the participation to the subject or his/her legal representative before asking to sign this form.
Signed:_____

PI or authorized assistant

Appendix E: Assent Form

I agree to participate in a study about my dietary habits.

I agree to recall what I ate and drank during a previous day for four days in a row on two different occasions and I agree to complete several questionnaires about eating fruits and vegetables.

I can tell my teacher if I do not want to do this anymore.

_____Yes, I want to help.

_____No, I do not want to help.

Name: _____

Date: _____

Appendix F- FV Knowledge

We want you to tell us what you know about healthful eating.

Please bubble your answer

1. Eating fruits and vegetables protects you from diseases.

- ☐ True
- ☐ False
- ☐ I don't know

2. Fruits and vegetables are high in fat and sugar.

- ☐ True
- ☐ False
- ☐ I don't know

3. Most of the vitamin C we get comes from fruits and vegetables.

- ☐ True
- ☐ False
- ☐ I don't know

4. Fruits and vegetables that are high in vitamin A are _____ in color.

- ☐ Red and white
- ☐ Blue and light brown
- ☐ Orange and yellow
- ☐ Brown and purple
- ☐ I don't know

5. Almost all fruits and vegetables contain lots of vitamins and _____.

- ☐ Protein
- ☐ Minerals
- ☐ Cholesterol
- ☐ Fat
- ☐ I don't know

6. Which of the following fruits and vegetables are grown in Oklahoma?

- ☐ Tomatoes
- ☐ Watermelons
- ☐ Okra
- ☐ All of the above

Appendix G- FV Preferences (Baranowski, 2000)

How much do you like these fruits and vegetables? Please bubble your answer ●

	I do not like this	I like this a little	I like this a lot	I don't know what this is
				
Apples	?	?	?	?
Asparagus	?	?	?	?
Avocados	?	?	?	?
Blackberries	?	?	?	?
Blueberries	?	?	?	?
Broccoli	?	?	?	?
Cabbage	?	?	?	?
Cantaloupe	?	?	?	?
Carrots	?	?	?	?
Cauliflower	?	?	?	?
Cherries	?	?	?	?
Corn	?	?	?	?
Cucumbers	?	?	?	?
Eggplant	?	?	?	?
Grapefruit	?	?	?	?
Green beans	?	?	?	?
Honeydew melon	?	?	?	?
Lettuces	?	?	?	?
Mushrooms	?	?	?	?
Okra	?	?	?	?
Onions	?	?	?	?
Oranges	?	?	?	?
Peaches	?	?	?	?

Pears	☐	☐	☐	☐
	I do not like this 	I like this a little 	I like this a lot 	I don't know what this is 
Peas	☐	☐	☐	☐
Peppers	☐	☐	☐	☐
Plums	☐	☐	☐	☐
Potatoes	☐	☐	☐	☐
Pumpkins	☐	☐	☐	☐
Radishes	☐	☐	☐	☐
Spinach	☐	☐	☐	☐
Squash	☐	☐	☐	☐
Strawberries	☐	☐	☐	☐
Sweet potatoes	☐	☐	☐	☐
Tomatoes	☐	☐	☐	☐
Watermelons	☐	☐	☐	☐
Zucchini	☐	☐	☐	☐

Appendix H- Self-efficacy (adapted from Baranowski, 2000)

	Please bubble your answer ?				
	I disagree very much 	I disagree a little 	I am not sure 	I agree a little 	I agree very much 
1. For breakfast I think I can drink a glass of my favorite juice	?	?	?	?	?
2. For breakfast I think I can add fruit to my cereal	?	?	?	?	?
3. For lunch at school, I think I can eat a vegetable that's served	?	?	?	?	?
4. For lunch at school, I think I can eat a fruit that's served	?	?	?	?	?
5. For lunch at home I think I can eat carrot or celery sticks instead of chips	?	?	?	?	?
6. For lunch at home I think I can eat my favorite fruit instead of my usual dessert	?	?	?	?	?
7. For a snack I think I can choose my favorite fruit instead of my favorite cookie	?	?	?	?	?
8. For a snack I think I can choose my favorite fruit instead of my favorite candy bar	?	?	?	?	?
9. For a snack I think I can choose my favorite raw vegetable instead of my favorite cookie	?	?	?	?	?
10. For a snack I think I can choose my favorite raw vegetable instead of my favorite candy bar	?	?	?	?	?
11. For a snack I think I can choose my favorite raw vegetable instead of chips	?	?	?	?	?

	I disagree very much 	I disagree a little 	I am not sure 	I agree a little 	I agree very much 
12. For dinner I think I can eat a serving of vegetables	☐	☐	☐	☐	☐
13. For dinner I think I can eat my favorite fruit instead of my usual desert	☐	☐	☐	☐	☐
14. I think I can write my favorite fruit or vegetable on the family's shopping list	☐	☐	☐	☐	☐
15. I think I can ask someone in my family to buy my favorite fruit or vegetable	☐	☐	☐	☐	☐
16. I think I can go shopping with my family for my favorite fruit or vegetable	☐	☐	☐	☐	☐
17. I think I can pick out my favorite fruit or vegetable at the store and put it in the shopping basket	☐	☐	☐	☐	☐
18. I think I can ask someone in my family to make my favorite vegetable dish for dinner	☐	☐	☐	☐	☐
19. I think I can ask someone in my family to serve my favorite fruit at dinner	☐	☐	☐	☐	☐
20. I think I can ask someone in my family to have fruits and fruit juices out where I can reach them	☐	☐	☐	☐	☐
21. I think I can ask someone in my family to have cut up vegetables out where I can reach them	☐	☐	☐	☐	☐

Appendix I- Outcome Expectations for Eating FVs (Reynolds, et al.)

How much do you agree or disagree with the following statements?	Please check ☐ your answer		
	Disagree	Not Sure	Agree
1. Eating fruits and vegetables will make me smarter.	1. ☐	2. ☐	3. ☐
2. I will be better at sports if I eat fruits and vegetables.	1. ☐	2. ☐	3. ☐
3. I will get sick more often if I don't eat fruits and vegetables.	1. ☐	2. ☐	3. ☐
4. Eating fruits and vegetables will help me grow.	1. ☐	2. ☐	3. ☐
5. I will have healthier skin if I eat fruits and vegetables.	1. ☐	2. ☐	3. ☐
6. Eating fruits and vegetables will keep me from getting cancer.	1. ☐	2. ☐	3. ☐
7. If I eat fruits and vegetables, my family will be proud of me.	1. ☐	2. ☐	3. ☐
8. Eating fruits and vegetables will help me see better at night.	1. ☐	2. ☐	3. ☐
9. If I eat fruits and vegetables at breakfast, I will be able to think better in class.	1. ☐	2. ☐	3. ☐
10. Drinking juice will give me quick energy.	1. ☐	2. ☐	3. ☐
11. Eating fruits and vegetables will keep me from getting cavities.	1. ☐	2. ☐	3. ☐
12. If I eat fruits and vegetables, I won't get fat.	1. ☐	2. ☐	3. ☐

13. How old are you? _____
Years

14. Are you ○ Boy
○ Girl

15. How do you describe yourself? (You may fill out more than one)

○ Latino, Hispanic
○ Black, African American
○ White
○ American Indian
○ Asian, Pacific Islander

VITA

Ryan Fiddler

Candidate for the Degree of

Master of Science or Arts

Thesis: DOES THE "VEGGIE U" CURRICULUM INCREASE NUTRITIONAL KNOWLEDGE, SELF-EFFICACY, OUTCOME EXPECTATIONS, AND PREFERENCES RELATED TO FRUITS AND VEGETABLES IN 5TH GRADE CHILDREN?

Major Field: Nutritional Sciences

Biographical:

Personal Data:
2415 N Star Dr
Stillwater, OK 74075
Cell phone: (918) 633-3578
Email: ryan.fiddler@okstate.edu

Education:
Completed the requirements for the Master of Science in Nutritional Sciences at Oklahoma State University, Stillwater, Oklahoma in May, 2009.

Experience:
Poster presentation at the Central States Regional ACSM meeting October 16th, 2008 in Springfield, MO:

- R. Fiddler, D. Smith, B. Jacobson, J. Fedick, J. Guerrero, C. Kline, A. Boolani, A.B. Harrison Human Performance Laboratory, Oklahoma State University, Stillwater *The Effect of Energy Patches on Substrate Utilization in College Male Cross-Country Runners***.**

Publications:
Smith, D., Jacobson, B., Fedick, J., Guerrero, J., Kline, C., Boolani, A., Fiddler, R. *The effects of energy patches on graded exercise test performance in college male cross-country runners*. Med Sci Sport Exer. 2008;40(5)S417.

Name: Ryan Fiddler Date of Degree: May 2009

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: DOES THE "VEGGIE U" CURRICULUM INCREASE NUTRITIONAL KNOWLEDGE, SELF-EFFICACY, OUTCOME EXPECTATIONS, AND PREFERENCES RELATED TO FRUITS AND VEGETABLES IN 5TH GRADE CHILDREN?

Pages in Study: 72 Candidate for the Degree of Master of Science

Major Field: Nutritional Sciences

Scope and Method of Study: Experimental study on the effectiveness of a nutrition education curriculum at increasing knowledge related to fruit and vegetables, preferences for fruit and vegetables, self-efficacy for selecting fruit and vegetables, and outcome expectations of consuming fruit and vegetables in 5th grade children.

Findings and Conclusions: The Veggie U curriculum significantly increased fruit and vegetable familiarity in 5th grade children from pretest to posttest. However, no significant change was observed in other psychosocial variables measured.

ADVISER'S APPROVAL: _____