THE EFFECTS OF NUTRITION EDUCATION AND GARDENING ON ATTITUDES, PREFERENCES AND KNOWLEDGE OF 2ND-5TH GRADERS IN HIDALGO COUNTY, TEXAS REGARDING FRUITS AND VEGETABLES

A Thesis

by

GERALYN A. NOLAN

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

December 2005

Major Subject: Horticulture

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Approved by:

Chair of Committee,	Jayne M. Zajicek
Committee Members,	Gary E. Briers
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ABSTRACT

The Effects of Nutrition Education and Gardening on Attitudes, Preferences and Knowledge of 2nd-5th Graders In Hidalgo, Texas Regarding Fruits and Vegetables. (December 2005)

Geralyn A. Nolan, B.S., Texas A&M University

Chair of Advisory Committee: Dr. Jayne M. Zajicek

Child obesity has become a national concern. Obesity in children ages 6-17 has more than doubled in the past 30 years. Only 20% of children today consume the recommended daily servings of fruits and vegetables. This trend is even more pronounced in minority populations. Past studies have reported that a horticulture-based curriculum, including gardening, can improve children's attitudes toward eating fruits and vegetables. To investigate whether children of a minority population can benefit from gardening supplemented with a curriculum on nutrition, research was conducted with elementary schools in the Rio Grande Valley of Texas (Hidalgo County). Elementary school teachers participating in this research agreed to have school gardens and complete all activities in a curriculum on nutrition provided to them through the Texas Extension Service. One hundred forty one children in the participating schools completed a pre- and posttest evaluating their attitudes and snack preferences toward fruits and vegetables and their knowledge before and after gardening supplemented with information on nutrition. Statistically significant differences were detected between pre- and posttest scores for all three variables. After comparing pre-and posttest scores, it

was concluded that gardening with supplemental instruction, had a positive effect on all three variables including students attitudes and snack preferences toward fruits and vegetables and their knowledge of nutrition.

DEDICATION

To mom and dad, for inspiring me to learn and grow.

To Mark, for his unconditional love, support, patience, and sacrifice.

To Annabelle, with love and hope.

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Finally, this would not have been possible without the encouraging support of my husband and our families. I truly appreciate your patience and the sacrifices you have made that have allowed me to continue my quest for learning.

TABLE OF CONTENTS

LIST OF FIGURES

FIGURE Page

LIST OF TABLES

TABLE Page

TABLE Page

CHAPTER I

INTRODUCTION

Over the years children in America have consistently consumed fewer than the recommended servings of fruits and vegetables (Domel et al., 1993a; Subar et al., 1995; CDC, 1996; Krebs-Smith et al., 1996; Cullen et al., 2001). Instead they are consuming high fat, calorically dense, nutrient poor foods and as a result, the number of overweight children continues to increase to record numbers (CDC, 1996; Blumenthal et al., 2002). As a result of the increase in overweight and obese children, the prevalence of type II, adult type, diabetes in children is also on the rise (St-Onge et al., 2003).

The consumption of fruits and vegetables is vital to the health of children and adults (Domel et al., 1993a; Kirby et al., 1995; Ness and Powles, 1997; Liu et al., 2000; Bazzano et al., 2002; Cullen et al., 2002; Djoussé et al., 2004). Fruit and vegetable consumption decreases the risk for cardiovascular disease, (Liu et al., 2000) decreases concentrations of LDL cholesterol, (Djoussé et al., 2004) and lowers stroke incidence (Bazzano et al., 2002). Including fruits and vegetables consistently in a diet can also assist with weight control (Lin and Morrison, 2002). This may be a result of fruits and vegetables being a food that is nutrient dense and generally low in calories.

Low income populations tend to consume even less fruits and vegetables

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This thesis follows the recommended style and format of the Journal of the American Society for Horticultural Science.

(Treiman et al., 1996) and are at greater risk of being overweight and obese (Morton and Guthrie, 1999; Wang, 2001). Oftentimes fruits and vegetables are not available in the homes of low income children because their parents feel that fresh produce is too expensive, hard to select, and difficult to store (Treiman et al., 1996). Children in low income families are not being taught the importance of fresh fruits and vegetables or being given the opportunity to taste them at home.

Food preferences and dietary habits are established during childhood (Kirby et al., 1995; Carter, 2002). This means that interventions need to be targeted at young children while they are forming their lifelong habits. Since most children are enrolled in school, the classroom is a suitable place to teach nutrition education. There are many ways a teacher can teach nutrition, however this study focused on a hands-on nutrition curriculum combined with gardening.

School-based nutrition education increases nutritional knowledge and causes a positive attitude change towards healthy eating in most grade levels (Contento, 1992). School gardens are a way to teach students using hands-on activities that are fun and teach skills at the same time. Gardening provides hands-on activities through the actual growing and harvesting of the vegetables, and by their preparation as food. Gardening and related activities increase positive attitudes about, preferences for, and willingness to taste new fruits and vegetables (Lineberger and Zajicek, 2000; Morris et al., 2001).

Purpose and Objectives

The purpose of this study was to evaluate whether *Health and Nutrition from the Garden* (Genzer et al., 2001) combined with gardening can improve children's knowledge about nutrition and improve the attitudes they have toward fruits and vegetables.

The objectives of this study were to:

1. Evaluate the effect of participation in gardening and the *Health and Nutrition from the Garden* curriculum on children's nutritional knowledge.
2. Evaluate the effect of participation in gardening and the *Health and Nutrition from the Garden* curriculum on children's attitudes toward fruits and vegetables.
3. Evaluate the effect of participation in gardening and the *Health and Nutrition from the Garden* curriculum on children's preferences for fruits and vegetables.

Research Questions

The research questions addressed by these objectives were:

1. Did participation in gardening and the *Health and Nutrition from the Garden* curriculum affect elementary students' nutritional knowledge?
2. Did participation in gardening and the *Health and Nutrition from the Garden* curriculum affect elementary students' attitudes towards fruits and vegetables?
3. Did participation in gardening and the *Health and Nutrition from the Garden* curriculum affect elementary students' preferences for fruits and vegetables?

Definition of Terms

For the purpose of this study, the following terms were operationally defined:

Nutrition: Necessary daily intake of foods by individuals.

Nutrition Education: The process of teaching information related to nutrition.

Nutritional Knowledge: Acquisition and comprehension of facts and processes related to nutrition.

Nutritional Attitude: Feelings towards or about a specific nutritionally related item.

Nutritional Preference: The selection of a food or nutritional item over another.

Fruits and Vegetables: Food items consisting of or produced by plants.

Fruit or Vegetable Intake: Consumption of fruits or vegetables.

Elementary School Student: A student enrolled in second through fifth grade.

Health and Nutrition from the Garden: Curriculum guide used for this study. *Health and Nutrition from the Garden* (Genzer et al., 2001).

Basic Assumptions

In this study, it was assumed that the curriculum guide and evaluative tool were used correctly and consistently by the teachers that administered them. It was also assumed that the students that participated were typical of their population. Lastly, it was assumed that the students understood the evaluative tool and answered the questions to the best of their ability.

Limitations of the Study

This study was comprised of a convenience sample. It was limited by the fact that it was not random in design. The researcher relied on teachers to volunteer their classes to participate in the study. Additionally, the researcher relied on Extension agents to train the teachers how to use the curriculum and how to garden.

Delimitation of the Study

This study was delimited to schools that had garden facilities. The sample was further delimited to individuals who completed the survey tools.

CHAPTER II

REVIEW OF LITERATURE

Nutrition education is important because of the impact it has on society. Everyone is affected by nutrition in their daily lives. Therefore, it is important that researchers know why nutrition is important and what groups are affected the most. This knowledge is beneficial to determine what kinds of interventions need to be implemented for future research. The literature reviewed in this chapter looks at the importance of a good diet including fruits and vegetables, the attitudes and behaviors that children have towards fruits and vegetables, how nutrition affects different populations, and research that has been conducted on nutrition education in schools. This chapter is grouped into the following categories.

1. The Importance of Good Nutrition for Children
2. Nutritional Attitudes and Behaviors of Children
3. Demographic Factors Affecting Nutrition
4. Nutrition Education in Schools

The Importance of Good Nutrition for Children

A mother's diet and nutritional intake is important during her pregnancy because it affects the cognitive, sensorimotor, and emotional development of her unborn child (Powney et al., 2000). However, malnutrition before the child reaches the age of two is just as damaging as malnutrition after age two. Under-nourished children that do not consume the proper vitamins and minerals, or the quantities required for development,

do not have the energy to play as much as properly nourished children and have a hard time concentrating (Troccoli, 1993; Symons et al, 1997). As a result of this, they learn more slowly and are less likely to be challenged by adults to talk and explore (Brown and Pollit, 1996).

Hungry/undernourished children are more likely to get sick (Troccoli, 1993; Symons et al., 1997; Brown, 2002). Children that do not receive the nourishment they need get more stomachaches, headaches, ear infections and more frequent colds than children that do receive proper nourishment (Wehler et al., 1995; Alaimo et al., 2001). These children are more likely to miss school and fall behind in their class work (Troccoli, 1993; Symons et al., 1997). This "cost also extends to our nation in terms of higher rates of school failure, poorer returns on our educational investments, and weakened workforce productivity when children reach the age of employment" (Brown, 2002, p.3).

Undernourishment also contributes to behavior problems in children (Brown, 2002). Compared to children that do receive proper nutrition, undernourished children have increased levels of anxiety and hyperactivity and tend to be more irritable and more aggressive. They also tend to be more withdrawn (Brown, 2002). However, an improvement in the child's diet after age two has been shown to improve cognitive, sensorimotor, and emotional development to almost normal levels (Brown and Pollit, 1996).

Early childhood is also a critical period for developing obesity (Law, 2001). The number of overweight children aged six to seventeen has increased by almost 200% in

the last thirty years, and those numbers continue to rise (MMWR, 1996; Law, 2001; Wang, 2001; Blumenthal et al., 2002; Weisberg, 2002; St-Onge et al., 2003; Jolliffe, 2004). Approximately 30% of children that are six to nineteen years old are overweight (Wang, 2001; St-Onge et al., 2003). According to the 1999-2000 National Health and Nutrition Examination Survey, approximately 65% of adult Americans are overweight or obese (NCHS, 2001; Law, 2001; St-Onge et al., 2003). Overweight and obesity has increased so rapidly that physicians are now calling it an epidemic and believe that it will soon pass smoking as the leading cause of preventable death in the United States (Blumenthal et al., 2002; Weisberg, 2002). The diseases that result from being overweight or obese are believed to be responsible for approximately 300,000 deaths per year in the U.S. (MMWR, 1996; Weisberg, 2002), and have been estimated to cost in excess of $200 billion annually for medical expenses and lost productivity (NCHS, 2001).

Childhood overweight and obesity has become an important topic because of the numerous health risks that are related to these health problems (MMWR, 1996; Dietz, 1997; USDHHS, 2001; Raman, 2002; St-Onge et al., 2003). Not all health risks develop later in adult life, children are also at a risk for certain diseases (MMWR, 1996). Children that are obese tend to have unfavorable fat storage levels, high blood pressure, hardening of the aorta and coronary arteries, and type 2, adult type, diabetes (Raman, 2002; Weisberg, 2002; Jolliffe, 2004). These diseases carry over into adulthood and have been linked to adult mortality (Wang, 2001). The prevalence of type 2 diabetes, especially in children, has continued to increase (Lin and Morrison, 2002; St-Onge et al.,

2003). Before 1992 the prevalence of type 2 diabetes in children ages birth to nineteen was 2-4%. In 1994 the number of cases of type 2 diabetes in children had dramatically increased to 16% (St-Onge et al., 2003).

In addition, an individual's diet is believed to be a major determinant in the origin of cardiovascular disease (Ness and Powles, 1997). Consumption of fruits and vegetables can help prevent health problems and promote growth and cognitive development (Domel et al., 1993a; Kirby et al., 1995; CDC, 1996; Ness and Powles, 1997; Djoussé et al., 2004). A healthy diet may also help prevent childhood and adolescent health problems such as eating disorders, dental cavities, and iron deficiency anemia (CDC, 1996).

Fruits and vegetables are important to a healthy diet because they contain nutrients that decrease the risk for cardiovascular disease and certain cancers (Domel et al., 1993a; Kirby et al., 1995; Ness and Powles, 1997; Liu et al., 2000; Bazzano et al., 2002; Cullen et al., 2002; Djoussé et al., 2004). Research conducted on a large sample of women found that consuming fruits and vegetables lowered their risk for cardiovascular disease, especially myocardial infarction (Liu et al., 2000). Djoussé et al. (2004) found that eating fruits and vegetables was linked to a decrease in concentrations of LDL cholesterol. Another study conducted by Bazzano et al. (2002) concluded that "the frequency of fruit and vegetable intake is inversely associated with stroke incidence, stroke mortality, ischemic heart disease mortality, cardiovascular disease mortality, and all-cause mortality in the general United States population".

A diet that stresses “antioxidant-rich” foods such as fruits and vegetables is believed to reduce the risk of developing certain diseases (Tribble, 1999). Fruits and vegetables are rich in antioxidants which is a “substance, such as vitamin E, vitamin C, or beta carotene, thought to protect body cells from the damaging effects of oxidation” (dictionary.com, June 16, 2004) and “greater antioxidant intake is associated with lower disease risk” (Tribble, 1999).

Fruits and vegetables can also have an impact on obesity. An examination of the relationship between fruit and vegetable consumption and body mass index (BMI), was conducted by USDA researchers, Lin and Morrison (2002). They found that people who consumed more fruit servings per day had lower BMI’s. In contrast, male and female adults and children who were overweight consumed significantly less fruit than those who were a healthy weight.

Nutrition Attitudes and Behaviors of Children

Food preferences, dietary habits, behavior, and lifestyle choices are all developed and established during childhood (Kirby et al., 1995; Carter, 2002). Therefore, any unhealthy eating practices that are established at an early age contribute to chronic disease because “young persons having unhealthy eating habits tend to maintain these habits as they age” (MMWR, 1996, p.5). Since many behaviors and lifestyle choices are developed while a child is in school, a student’s food intake and physical activity at school are important determinants of body weight (Carter, 2002).

Many children and adults do not meet the goal set by the USDA to consume at least five servings of fruits and vegetables daily (Domel et al., 1993a; Subar et al., 1995; CDC. 1996; Krebs-Smith et al., 1996; Cullen et al., 2001). According to the Five a Day Baseline Survey (Subar et al., 1995), the total population had a median weekly intake of 3.4 servings of fruits and vegetables per day and only 23% of the total population reports consumed five or more servings of fruits and vegetables on a daily basis (Domel et al., 1993a; Subar et al., 1995). A sample of children, aged 2-18, that participated in a three day diet record consumed, on average, 3.6 servings of fruit and vegetables daily, and a large portion of those vegetables reported were fried potatoes (Krebs-Smith et al., 1996). Of the children surveyed, only 20.4% did consume the recommended five or more servings of fruits and vegetables a day, 50.8% ate less than one serving of fruit per day, and 29.3% ate less than one non-fried vegetable daily (Krebs-Smith et al., 1996). A study conducted by Cullen et al. (2001) reported that the average daily fruit and vegetable intake was 2.13 servings and another study indicated that only 5% of seven to fourteen year olds met the “five a day” fruits and vegetables recommendation, (St-Onge et al., 2003) both of which are a decrease from the previous study. A 24 hour diet recall of high school students indicated that 41% of the students surveyed did not consume any vegetables and 42% ate no fruit the day before they participated in the survey (MMWR, 1996). The percentages of fruits and vegetables consumed also decreased as the children got older.

The amount of fat, saturated fat, and calories consumed has increased while physical activity has declined, which contributes to the rising number of overweight

children (CDC, 1996; Blumenthal et al., 2002). Between 1994 and 1997 there was more than a 15% increase in the average daily calorie intake per person in the United States (Blumenthal et al., 2002). Part of this may be due to the increase in the prevalence of snacking between meals and the increase in fast food consumption, because fast food consumption is connected with lower intakes of fruits and vegetables (St-Onge et al., 2003). In 1996 it was reported that of children aged six to seventeen, 84% ate too much fat, and 91% ate too much saturated fat (CDC, 1996). In 2002, the amount of physical activity among Americans had declined, with 74% of adults stating that they did not engage in the amount of physical activity recommended by the U.S. Department of Health and Human Services (Blumenthal et al., 2002). During the time between 1991 and 2001, the percentage of students attending daily physical education classes declined from 42% to 32% respectively (Blumenthal et al., 2002).

There are many different attitudes that children and their parents have about food, especially fruits and vegetables (Contento, 1981; Kirby et al., 1995). According to a study conducted by Kirby et al. (1995), many adults believe that children eat what their parents eat or they eat what their peers eat. Many children believe that "if it's good for you, then it must be bad" (Kirby et al., 1995). The translation is that if something is healthy, then it must taste nasty, because the children interviewed said that "veggies taste nasty" (Kirby et al., 1995). Both parents and children view eating out as a treat and would not normally order fruits and vegetables (Kirby et al., 1995).

A qualitative study conducted by Contento (1981) about food knowledge and attitudes revealed that children thought that "good for you" foods were fruits, vegetables,

and meat, “food” was non-sweet foods, and “other foods” consisted of desserts and candy. There was a difference between “food” and “snacks” and they were aware that “food” makes one “strong” and “healthy” and “made you grow.” However, they did not know how or why food did those things.

A more recent study by Cullen et al. (2000) found that students did report that peers affect the choices they make in regards to fruits and vegetables; however negative comments about eating vegetables were not likely to cause them to stop eating a vegetable they liked. The children and parents interviewed said that “all kids like candy more than fruit” and parents said that “Most of the children eat the same thing, a lot of junk food” (Cullen et al., 2000). Most of the children preferred starches over vegetables and most reported that they ate out for dinner at least twice a week (Cullen et al., 2000).

Preference for and positive attitudes about fruits and vegetables have been major predictors of fruit and vegetable consumption (Domel et al., 1993a; Resnicow et al., 1997; Cullen et al., 2000). Since many chronic disease processes begin in childhood and carry over into adulthood and dietary preferences are learned while children are young, strategies should be aimed at younger children to increase their preferences and positive attitudes towards fruits and vegetables (Baranowski et al., 1997). Strategies aimed at younger children tend to have better long-term results than strategies focused on adolescents (Carter, 2002).

Demographic Factors Affecting Nutrition

"SES [socioeconomic status] remains a persistent and pervasive predictor of variations in health outcomes" (Williams and Collins, 1995, p.350) and as a result should be scrutinized more closely. The population for this research using the *Health and Nutrition from the Garden* curriculum and gardening was largely of Hispanic or Latino origin and of very low SES. In 2002, the United States population consisted of 37.4 million Latinos, with 34.8% of the Southern population and 44.2% of the Western population consisting of Latinos. In contrast, a smaller percentage of the Southern and Western populations, 33.3% and 19.2%, respectively, consisted of non-Hispanic Whites (USCB, 2000). Approximately 40% of the general population studied lives below the poverty level (USCB, 2000).

Socioeconomic Status

Childhood and adolescent obesity is related to SES (Raman, 2002; Wang, 2001). Low income families are less aware of relationships between diet and disease, less likely to utilize the nutrition panel on food labels, and less likely to have low fat and low cholesterol diets (Morton and Guthrie, 1999). Oftentimes fruits and vegetables are not available in the homes of low income children (Kirby et al., 1995; Baranowski et al., 2000; Cullen et al., 2003) and as a result, "low income populations have lower levels of fruit and vegetable consumption than do higher income populations" (Treiman et al., 1996, p. 149).

Fresh fruits and vegetables are often thought of as too expensive in the low SES groups (Kirby et al., 1995; Treiman et al., 1996; Morton and Guthrie, 1999). A study conducted of mothers in the WIC program by Treiman et al. (1996), found that although the mothers had positive perceptions of fruits they said they were too expensive, hard to select, and difficult to store, and these were all reasons they often did not purchase fresh fruits for their families. They also considered vegetables to be healthy, but felt that vegetables were difficult to prepare and they were not well liked by their families (Treiman et al., 1996). Research by Morton and Guthrie (1999) found similar results. "Low income respondents with children were more concerned with price, convenience and how well food keeps than were higher income participants" (Morton and Guthrie, 1999, p.26). However, this does not mean that they do not have fruits and vegetables in the home. Lower SES groups report having more frozen and canned fruits and vegetables than fresh in the home; the only fresh purchase is usually the child's favorite fruit or vegetable (Kirby et al., 1995).

Income and education have an inverse effect on rates of mortality; higher levels of income and education are associated with lower rates of mortality (Williams and Collins, 1995). This may be because "children with a history of malnutrition are usually born into families with the lowest levels of income and with the lowest levels of education" (Pollitt, 1984, p.444). Also, low SES populations tend to have elevated rates of illness due to their low socioeconomic situation (Williams and Collins, 1995). A qualitative study conducted by Kirby et al. (1995, p.266) found that the high SES groups mentioned that eating fruits and vegetables may help prevent chronic diseases like

"cardiovascular disease, hypertension, and colon cancer," while the low SES group only thought of the general benefits mentioning that "fruits and vegetables will make you healthier". Morton and Guthrie (1999) also found that low income families compared to higher income families were less likely to know how many serving of vegetables are recommend. Even though 99% of mothers in a WIC program study (Treiman et al., 1996) felt that being a good role model for their children was the most important thing they could do for them, they thought it was odd to eat a piece of fruit for a midday snack. They felt a snack should be sweet or salty like chocolate or junk food and they were more concerned with what they fed their children than what they ate themselves (Treiman et al., 1996). They have good intentions, but they lack the nutrition education to understand and support their feelings.

In the United States the prevalence of overweight and obesity is greatest among the low income groups (Morton and Guthrie, 1999; Wang, 2001). Morton and Guthrie (1999) found that their low income group had a mean body mass index of 27 while the higher income group had a body mass index of 26. This difference was found to be statistically significantly different. Frongillo et al. (1996) also found that low SES populations tend have a higher body mass index than those that have higher incomes. A study conducted by Wang (2001) of children ages 6 to 18 found that 32.7% of the low income population was classified as being overweight or obese compared to 19% of the high income population. The prevalence of overweight and obesity in low income populations may be a result of the consumption of low cost foods that are high fat and calorie dense, which happens when the families lack the money to buy nutritious foods

(Brown, 2002). Low income families also report eating at fast food restaurants more frequently where children report that they do not tend to order fruits and/or vegetables (Kirby et al., 1995). Higher SES groups typically can afford to buy and consume more fruits and vegetables which are not calorie dense (Wang, 2001), thus less likely to gain weight.

Ethnicity

In 2002, according to the U.S. Census Bureau, the Hispanic population had the largest percentage under age eighteen. While 34.4% of Hispanics were 18 or younger, only 22.8% of non-Hispanic Whites were under eighteen years of age (USCB, 2000). Approximately 40% of Hispanics aged 25 or older do not have a school diploma compared to 88% of non-Hispanic Whites that have graduated from high school (USCB, 2000). Also, 21.4% of Hispanics live in poverty compared with 7.8% of non-Hispanic Whites. This means that even though Hispanics represent only 13.3% of the total population, they constitute 24.3% of the population living in poverty. The statistics for Hispanic children are worse. "Hispanic children represent 17.7 percent of all children in the United States but constitute 30.4 percent of all children in poverty" (USCB, 2000, p.6).

Hispanic children are at a higher risk for overweight and obesity compared to White children (Wang, 2001). Cullen et al. (2002) found that Hispanic children on average consumed only 0.43 servings of fruit and 0.85 servings of vegetables per day compared to non-Hispanic White children who consumed, on average, 0.63 servings of

fruit and 1.18 servings of vegetables. For the "5 a Day Baseline Survey" male Hispanics reported the lowest intakes of fruit and vegetable servings per week and the youngest and oldest age groups among Hispanics reported consuming the lowest intakes of total fruits and vegetables (Subar et al., 1995). Hispanic females are more likely to have a higher body mass index than non-Hispanic White females (Wang, 2001). Hispanic parents also report significantly less "meal planning practices" than non-Hispanic White parents (Cullen et al., 2002).

Nutrition Education in Schools

Habits that begin in childhood often continue into adulthood (Baranowski, 1997; Carter, 2002;). Furthermore, research has shown that overweight children may become overweight adults (Serdula et al., 1993) and that programs aimed at the treatment of overweight children tend to have better success than those aimed at adults. Therefore, the prevention of childhood obesity may be effective in preventing adult obesity (Story, 1999). Since food preferences and dietary habits are formed during the early years of life and carry over into adulthood, childhood may be the best time to promote healthy foods (Kirby et al., 1995; Baranowski, 1997).

Children are not being taught the importance of healthy eating habits at home; therefore it is left up to other venues like schools. Unfortunately these venues may also be inadequate sources of nutrition education. The average amount of time elementary teachers spend on nutrition education is eleven hours per year (Contento et al., 1992). Woodson et al. (1995) surveyed 295 teachers from elementary, middle, and high schools

in Nevada to determine the status of school-based nutrition education. From the elementary teachers, she found that in one school year 17% spent less than one hour teaching nutrition, 61% spent between one and five hours, and 22% spent more than five hours teaching nutrition education. Of all the teachers surveyed, 80% thought nutrition should be taught during kindergarten through second grade (Woodson et al., 1995).

"Well-designed, well-implemented school-based nutrition education programs can improve the eating habits of young people" (CDC, 1996, p.45) and positively impact nutritional health (Lytle et al., 1997; Story, 1999). School based nutrition education increases nutritional knowledge and causes a positive attitude change towards healthy eating in most grade levels (Contento et al., 1992). Domel et al. (1993a) found that a curriculum designed to enhance students' abilities to ask for and prepare fruits and vegetables did significantly increase the students' fruit and vegetable knowledge and preference, but not their behavior.

Gardening

The Center for Disease Control (1996) reported that schools may help to accomplish increased fruit and vegetable intake of children by teaching the skills needed to practice healthy eating and by making the learning activities fun. School gardens are a way to teach students using hands-on activities that are fun and teach skills at the same time. Gardening provides hands-on activities through the actual growing and harvesting of the vegetables, followed by preparing them for consumption.

Research by Lineberger and Zajicek (2000) reported that participation in gardening and related activities significantly increased the vegetable attitude scores and fruit and vegetable snack preference scores of third through fifth grade students, but did not increase behavior. First grade students that participated in gardening and nutrition education lessons that were integrated into the curriculum were more willing to try new vegetables than those that did not garden. Other studies indicated that hands-on gardening increased children's awareness of and willingness to taste new fruits and vegetables (Morris et al., 2001).

Additional research by Morris et al. (2002) reported that nutrition lessons alone and nutrition lessons combined with gardening improved nutritional knowledge and vegetable preference of fourth grade students. However, the nutrition lessons combined with gardening increased their preferences for more vegetables and had better long term effects on the students' vegetable preferences (Morris et al., 2002).

CHAPTER III

METHODOLOGY

The research conducted in this study investigated the effectiveness of the curriculum guide *Health and Nutrition from the Garden* of the Junior Master Gardener$_{sm}$ Golden Ray Series$_{sm}$ combined with active participation in a school garden. This is a special thematic unit of the Junior Master Gardener$_{sm}$ (JMG$_{sm}$) program. The JMG$_{sm}$ program was developed by Texas Cooperative Extension, in conjunction with numerous other individuals and agencies, to educate youth about horticulture, health, nutrition, environmental science, and leadership and life skills (Genzer et al., 2001).

This study evaluated the effectiveness of a horticulture-based nutrition curriculum combined with gardening. Chapter III describes the procedures involved in evaluating the elementary students' attitudes towards fruits and vegetables and their nutritional knowledge after completing the *Health and Nutrition from the Garden* curriculum and participating in gardening. This study was approved by the Institutional Review Board at Texas A&M University on September 4, 2003.

Educational Curriculum

The curriculum used for this study was *Health and Nutrition from the Garden,* a special thematic unit of the Golden Ray Series$_{sm}$ of the JMG$_{sm}$ program (Genzer et al., 2001). This curriculum is designed to be used in many different settings including public, private and home schools, 4-H clubs, community organizations, and botanical

gardens. The main goal of the *Health and Nutrition from the Garden* curriculum is to teach children healthy eating habits on a limited budget.

The *Health and Nutrition from the Garden* curriculum is composed of two gardening concepts; 1) basic gardening and growing techniques, and 2) four nutrition concepts including Thrifty Gardens, ABC's of Healthful Eating, Food Safety, and Healthful Snacks. Each concept is comprised of approximately six activities. These activities range from growing seeds, worksheets, crafts, games, and cooking. The activities are then followed by either discussion questions or a written activity to reinforce the concept learned.

For example, the teaching concept, Thrifty Gardens, includes an activity titled Seed Bank (*Health and Nutrition from the Garden,* p.45). The objective for Seed Bank is to collect seeds from fruits and vegetables to be used in the next planting season. The students are taught how to dry seeds from fresh fruits and vegetables and the proper storage of these seeds. The follow up discussion includes an entrepreneurial component involving either selling the saved seeds, donating the seeds, or donating the money students make from selling the seeds (Genzer et al., 2001).

Teachers were encouraged to work towards student certification through the JMG_{sm} program. To become certified a student must be taught all of the concepts and complete at least twelve activities, preferably two from each of the teaching concepts, one life skill and career exploration activity, and one community service project. Most classrooms reported that they taught all of the concepts and completed most of the activities.

Population

This research study was conducted by the Texas Cooperative Extension Service of Hidalgo County with participants from elementary schools in the Rio Grande Valley of Texas. A pretest was conducted in August 2002 and a posttest was administered in March of 2003. Schools were recruited to participate through the Texas Cooperative Extension Service and the Junior Master Gardener $(JMG)_{sm}$ program. The teachers who volunteered their classes to participate in this study attended a 6-day workshop in June of 2002 presented by the Hidalgo County Texas Cooperative Extension Agents. At the workshop, they observed demonstrations, participated in mini workshops, attended seminars, and went on a field trip to an orchard. In addition, teachers were given the curriculum to take back to their school to teach in their classrooms.

There were a total of 141 second through fifth grade students who participated in this study. Complete data sets were collected from nine different classrooms in four different public schools in the Rio Grande Valley. A summary of participating schools is found in Table 1. The following paragraphs provide the numbers of children participating in the study from each school and a description of the population characteristics for that school by U.S. zip code according to the 2000 U.S. Census Bureau data (USCB, 2000).

Table 1. Summary of schools participating in the *Health and Nutrition from the Garden* study.

Participating Elementary School	Location by U.S. Zip Code	Number of Students Partcipating	Grade Level
MIMS	78572	16	2
McAuliffe	78501	15	2
Gonzales	78521	15	3
MIMS	78572	20	3
McAuliffe	78501	17	3
Salinas	78557	12	4
McAuliffe	78501	15	4
Gonzales	78521	19	5
McAuliffe	78501	11	5

MIMS Elementary

There were sixteen second graders and twenty third graders from MIMS Elementary that participated in the *Health and Nutrition from the Garden* curriculum and gardening project that completed both the pretest and posttest (Table 1). According to the 2000 U.S. Census Bureau there were 12,439 children aged five to nine in this region. The median household income was $23,799 and 33% of the households earned $14,999 or less in 1999. Of families with related children under eighteen years of age, 42.2% had household incomes below the poverty line. Of those sampled by the U.S. Census Bureau, 88.4% were Hispanic or Latino. (USCB, 2000)

Gonzales Elementary

There were fifteen third grade and nineteen fifth grade students that participated in the study from Gonzales Elementary (Table 1). According to the 2000 U.S. Census Bureau there were 8,661 children aged five to nine in this region. The median household

income was $23,426 and 32.9 % of the households earned $14,999 or less in 1999. Of families with related children under eighteen years of age, 40.6% had household incomes below the poverty line. Of those sampled by the U.S. Census Bureau, 93.4% were Hispanic or Latino.

Salinas Elementary

There were twelve fourth grade students that participated in the *Health and Nutrition from the Garden* curriculum and gardening project that completed both the pretest and posttest (Table 1). According to the 2000 U.S. Census Bureau there were 935 children aged five to nine in this region. The median household income was $19,397and 37% of the households earned $14,999 or less in 1999. Of families with related children under eighteen years of age, 41.7% had household incomes below the poverty line. Of those sampled by the U.S. Census Bureau, 97.8% were of Hispanic or Latino origin.

McAuliffe Elementary

There were fifteen second graders, seventeen third graders, fifteen fourth graders, and eleven fifth graders that participated in the *Health and Nutrition from the Garden* curriculum and gardening project that completed both the pretest and posttest (Table 1). According to the 2000 U.S. Census Bureau there were 4,783 children aged five to nine in this region. The median household income was $26,701 and 30.4 % of the households earned $14,999 or less in 1999. Of families with related children under

eighteen years of age, 35.8% had household incomes below the poverty line. Of those sampled by the U.S. Census Bureau, 84% were of Hispanic or Latino origin.

Instrumentation

The instrument used for the Health and Nutrition in the Garden study consisted of three segments. The first segment was a modified version of The Fruit and Vegetable Preference Questionnaire which measures students' nutritional attitudes regarding fruits and vegetables (Domel et al., 1993a). This instrument was developed by Dr. Tom Baranowski, Professor of Behavioral Nutrition, USDA-ARS Children's Nutrition Research Center, Dept. of Pediatrics, Baylor College of Medicine (Domel et al., 1993a). The questionnaire was created and used to identify fruit and vegetable preferences of fourth and fifth grade students participating in a "5 a Day for Better Health" based program called "Gimme 5" (Domel et al., 1993a). This instrument was considered to be a "reliable, valid, and easy-to-administer tool for assessing fruit and vegetable preferences" (Domel et al., 1993b) The "5 a Day for Better Health" study reported internal consistency reliabilities of alpha=0.70 for the vegetable portion of the questionnaire, alpha=0.73 for the fruit portion of the questionnaire and alpha=0.74 for the snack portion of the questionnaire (Domel et al., 1993a). These reliabilities met the acceptable minimum reliability of alpha=0.70 recommended for nutrition education studies (Sapp and Jensen, 1997). This questionnaire was used again in a study involving Girl Scouts. Similar reliabilities of alpha=0.74 for the vegetable preference portion and alpha=0.72 for the fruit preference portion of the questionnaire were reported (Cullen et

al., 1997). This questionnaire was also used for a study involving second through fifth grade students. It reported internal consistency reliabilities of alpha=0.85 for the fruit portion of the questionnaire, alpha=0.81 for the vegetable portion of the questionnaire, and alpha=0.79 for the snack portion of the questionnaire (Lineberger, 1999).

The Fruit and Vegetable Attitude Questionnaire for the Health and Nutrition in the Garden study was comprised of two distinct sections. The first section consisted of 10 fruits and vegetables. The students were asked to circle an answer for how they felt about a specified fruit or vegetable. Instead of numbers for choice ratings, students rated their preference with a face symbol. "I like this a lot" was a smiley face, "I like this a little" was a neutral face, and "I do not like this" was a frowning face (Table 2).

Table 2. Fruit and vegetable attitude questionnaire for *Health and Nutrition from the Garden* study. [a]

	I like this a lot [x]	I like this a little [y]	I do not like this [z]
1. Orange Juice	☺	😐	☹
2. Apples	☺	😐	☹
3. Tomatoes	☺	😐	☹
4. Tangerines	☺	😐	☹
5. Grapefruit	☺	😐	☹
6. Lettuce (Green Salads)	☺	😐	☹
7. Green Beans	☺	😐	☹
8. Squash	☺	😐	☹
9. Broccoli	☺	😐	☹
10. Carrots	☺	😐	☹

[X] This choice received two points.
[Y] This choice received one point.
[Z] This choice received zero points.
[a] Scores range from 0 to 20 points.

The second section consisted of 10 snack preference questions. The students were asked to choose between fruit or vegetable snack and non-fruit or vegetable snack to be eaten as an after school snack (Table 3).

Table 3. Snack preference questionnaire for *Health and Nutrition from the Garden* study. [z]

11. An orange or grapefruit	Or	My favorite cookie
12. Peanut butter on bread	Or	Carrots
13. An orange or grapefruit	Or	My favorite ice cream
14. My favorite candy bar	Or	Celery
15. An orange or grapefruit	Or	My favorite soft drink
16. My favorite cookie	Or	My favorite raw vegetable and dip
17. My favorite chips	Or	Grapes
18. Bananas	Or	A fried apple pie
19. Fruit salad	Or	A candy bar
20. An apple	Or	Nachos

[Z] A fruit or vegetable snack choice was given one point, a non-fruit or vegetable snack choice was given zero points. Scores range from 0 to 10.

To analyze these questions, each answer received a score. The response “I like this a lot” was given a score of two points. The response “I like this a little” was given a score of one point. The response “I do not like this” was given zero points. The points were summed up so that each participant received a preference score that ranged from zero to twenty points. For the snack questionnaire, a student was given one point for choosing the fruit or vegetable snack and zero points for choosing the non-fruit or vegetable snack item. The points were summed up so that each participant received a snack score that ranged from zero to ten points. The higher the score the better the fruit or vegetable preference/attitude and snack preference/attitude.

The second segment of the instrument contained 13 multiple choice questions testing the knowledge that each student should have gained from the *Health and Nutrition from the Garden* curriculum and gardening project. It asked questions regarding food groups, vitamin sources, serving amounts, and other nutrition related questions (Table 4).

Table 4. Multiple choice knowledge questions for *Health and Nutrition from the Garden* study. [z]

1. What is an example of food from the Bread, Pasta, and Cereal Group?
   a. **Spaghetti** b. Apple c. Cucumber d. Cheese

2. What is an example of food from the Fruit and Vegetable Group?
   a. **Grapes** b. Rice c. Chicken d. Milk

3. Which fruit and vegetable is a good source of vitamin C?
   a. Spinach b. Garbanzo Beans c. Carrots d. **Orange**

4. Which fruit or vegetable is a good source of fiber?
   a. **Dry beans** b. Cheese c. Smooth peanut butter d. apple juice

5. Which fruit or vegetable is an example of a root crop?
   a. Oranges b. **Potatoes** c. Apples d. Pears

6. Who should follow the Food Guide Pyramid?
   a. Children b. Adults c. Teens d. **All of the Above**

7. How many servings of fruit should you eat a day?
   a. **2-4** b. 9-10 c. 1-2 d. 6-7

8. How many servings of vegetables should you eat a day?
   a. 10-11 b. 1-2 c. 7-8 d. **3-5**

9. On a nutrition label, calories measure what?
   a. **Amount of Energy** b. Amount of Fiber
   c. Amount of Sugar d. Amount of Calcium

10. **True** or False: No single food contains all necessary nutrients a body needs.

11. **True** or False: Fruits and vegetables are natural sources of vitamins A and C, which are two nutrients that may prevent some diseases, including cancer and heart disease.

12. **True** or False: The human body is composed of more than 70 percent water.

13. **True** or False: Plant foods such as fruit, vegetables, and grains do not contain cholesterol and most are low in fat.

[Z] Correct answers received one point.
[Y] Correct answers are shown in bold.

To analyze these questions, each correct answer received one point. An incorrect answer received zero points. The scores were summed so each participant received a score ranging from zero to thirteen points. The higher the score, the more knowledge the student had about the fruits, vegetables and nutrition.

Each questionnaire included a third segment that asked demographic information including the student's gender, ethnicity, and grade level. After the tests were returned to the Texas Cooperative Extension Agent, each test was coded with a different ID number for each participant so that the pretest and posttest could be matched.

Research Design

This research study followed the one-group pretest-posttest design to determine the effects of the intervention by comparing the pretest and posttest scores. All of the research participants completed the *Health and Nutrition from the Garden* curriculum and actively participated in the garden. A pretest and posttest that included the fruit and vegetable attitude questionnaire, the snack preference questionnaire, the knowledge questionnaire, and the demographic questionnaire were given to all students that participated in this study. The pretest was administered in September of 2002 before the students participated in gardening or used the curriculum. The posttest was administered in March of 2003 after the curriculum had been taught and the students had grown and harvested plants in the garden.

Data Analysis

Only students that completed all of the testing were included in the data analysis. Data were entered into a Microsoft Excel spreadsheet, and analyzed using the Statistical Package for the Social Sciences®, (SPSS) for Windows™ Version 12.0 (SPSS, 2003). Paired t-tests were conducted to compare the pretest to posttest scores for each section of the instrument. Additional comparisons using two-factor analysis of variance (ANOVA) with repeated measures were performed to determine exactly where the differences occurred.

CHAPTER IV

RESULTS AND DISCUSSION

This chapter contains the data analysis of the nutritional attitudes and knowledge of elementary school students who participated in the Nutrition in the Garden research study. The purpose of this study was to determine whether children who participated in gardening combined with the *Health and Nutrition from the Garden* curriculum (Genzer et al., 2001) improved their attitudes towards and nutrition preferences for fruits and vegetables, and improved their knowledge of nutrition.

There were four sections of the Health and Nutrition from the Garden instrument. A knowledge questionnaire was used to determine the students' knowledge of general nutrition. The fruit and vegetable attitude questionnaire and the snack preference questionnaire were used to assess attitudes towards fruits and vegetables. Finally, the demographic questionnaire was used to determine grade level, gender, ethnicity, and which school the participant attended. The survey was administered two times. The pretest was administered in September of 2002 before the students participated in gardening or used the curriculum. The posttest was administered in March of 2003 after the curriculum had been taught and the students had grown and harvested plants in the garden.

Nutrition Knowledge Section

There were two nutritional knowledge questions that were eliminated from the statistical analysis. One was eliminated as a result of a mis-score; the other was eliminated because the subject content was not presented clearly in the learning material. Pretest and posttest scores of the nutritional knowledge section were compared, and a paired t-test analysis revealed a statistically significant increase from the pretest to the posttest scores (Table 5). The result indicated that after students participated in gardening and the *Health and Nutrition in the Garden* curriculum (Genzer et al., 2001) their knowledge scores increased by 1.61 points. Based on this finding, additional comparisons were made to investigate the differences between pretest and posttest nutritional knowledge scores.

Table 5. Paired t-test comparing the pretest and posttest nutritional knowledge scores of students participating in the *Health and Nutrition from the Garden* study.

Group	Number of Cases	Mean Score[z]	Standard Deviation	df	t	Sig (2-tailed)
Pretest	141	6.87	1.939	140	-6.592	0.000*
Posttest	141	8.48	2.626	140		

[z] Scores range from 0.00 to 13.00.

* Significant at the 0.05 level.

Two factor ANOVAs with repeated measures (pretest and posttest) were performed to determine 1) if there were significant differences in fruit and vegetable pretest to posttest scores, 2) if there were significant differences between or among scores when participants were categorized by gender, ethnicity, grade level, and school, and 3) if there were

interactions between the pretest to posttest scores and the variables gender, ethnicity, grade level, or school.

Gender

For the knowledge portion of the instrument, the male students started with higher scores compared to the females with a difference in scores of 0.34 points as indicated by the descriptive pretest statistics. The male students also demonstrated a greater increase in knowledge scores by increasing their scores by 1.76 points while the female students increased their knowledge score by 1.48 points (Table 6).

Table 6. Descriptive statistics of knowledge scores pretest and posttest and by gender for the *Health and Nutrition from the Garden* study.

Gender	Number of Cases	Mean Score	Standard Deviation
Pretest			
Female	77	6.71	1.849
Male	64	7.05	2.043
Posttest			
Female	77	8.19	2.487
Male	64	8.81	2.765

However, a two factor analysis of variance with repeated measures for the pretest to posttest by gender indicated that both males and females significantly increased their knowledge scores from pretest to posttest and there was not a significant difference between scores of male and female students on the knowledge section of the survey (Table 7). This means that male and female scores improved similarly from pretest to

posttest. Figure 1 demonstrates this similar change in slopes for the females and males indicating no interaction between the two genders.

Table 7. Two factor ANOVA with repeated measures pretest to posttest of the knowledge section of the questionnaire for students participating in the Health and Nutrition from the Garden study by gender.

Source of Variation	df	SS	MS	F	Sig.
Pretest to Posttest	1	184.14	184.14	43.58	0.000*
Interaction of Gender and Pre/Post	1	1.420	1.420	0.340	0.563
Error (attitude)	139	587.35	4.23		
Gender	1	15.78	15.78	2.47	0.118
Error	139	887.05	6.38		

* Significant at the 0.05 level.

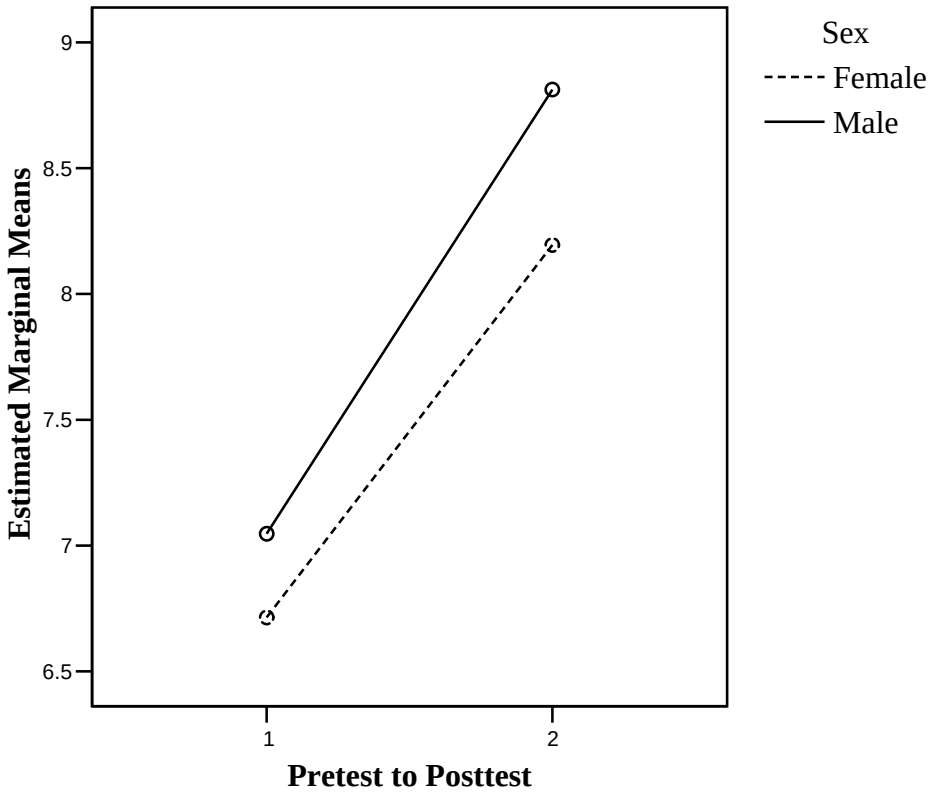

Figure 1. Interaction between the pretest to posttest scores of the knowledge section of the questionnaire for the students participating in the *Health and Nutrition from the Garden* study by gender.

Ethnicity

The descriptive statistics for ethnicity indicated that the greatest increase in knowledge scores was seen for the White participants who had an increase from pretest to posttest of 2.47 points. Black students increased their knowledge scores by 1.6 points and Hispanic students increased their knowledge scores by 1.53 points. All other ethnicities had an increase of 1.25 points for the knowledge section of the instrument (Table 8).

Table 8. Descriptive statistics of knowledge scores pretest and posttest and by ethnicity for the *Health and Nutrition from the Garden* study.

Ethnicity	Number of Cases	Mean Score	Standard Deviation
Pretest			
Hispanic	119	6.81	1.950
Black	5	7.00	2.121
White	13	7.38	1.895
Other	4	6.75	2.062
Posttest			
Hispanic	119	8.34	2.691
Black	5	8.60	0.894
White	13	9.85	2.267
Other	4	8.00	2.449

Because of the small number of participants that were White, Black, or Other, there was insufficient statistical power to detect differences; therefore, only descriptive statistics were used. A graphical representation of the scores indicates there were no interactions between the pretest/posttest change and ethnicity (Figure 2). The rate of change for each ethnicity was similar between the pretest and posttest scores.

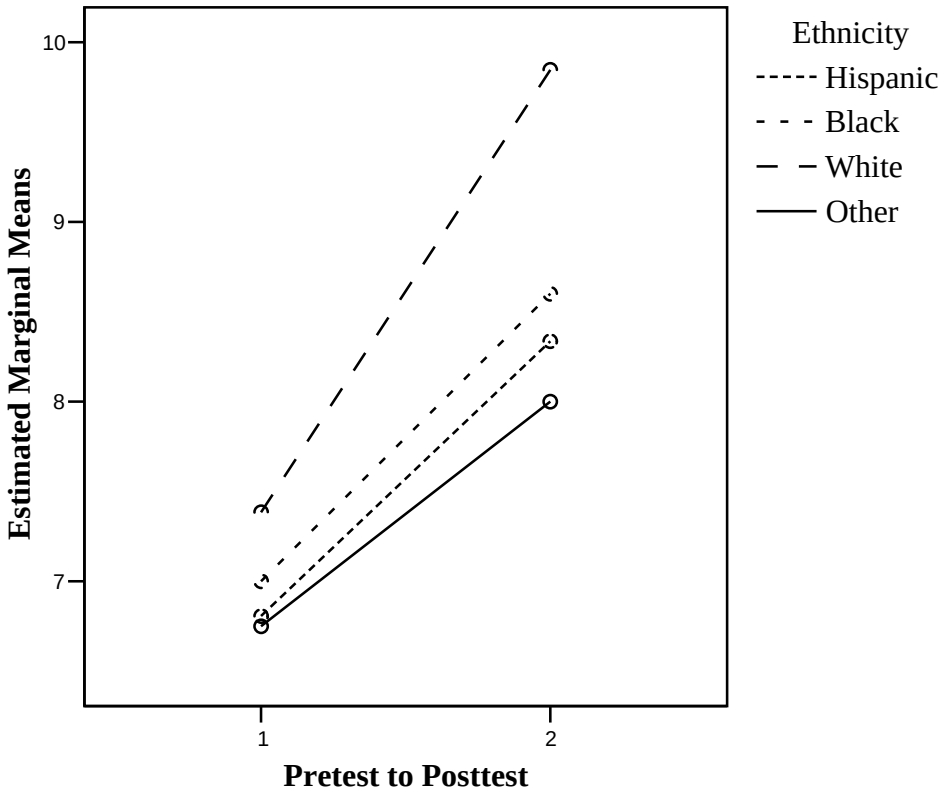

Figure 2. Interaction between the pretest to posttest scores of the knowledge section of the questionnaire for the students participating in the *Health and Nutrition from the Garden* study by ethnicity.

Grade Level

The descriptive statistics for the pretest to posttest scores for knowledge by grade level indicated that second graders had the greatest increase in knowledge scores from pretest to posttest with an increase of 2.25 points. Fourth and third graders were very close with increases of 2.00 and 1.90 points, respectively. The least increase in knowledge scores was for fifth graders who increased their scores by only 0.38 points (Table 9).

Table 9. Descriptive statistics of knowledge scores pretest and posttest and by grade level for the *Health and Nutrition from the Garden* study.

Grade	Number of Cases	Mean Score	Standard Deviation
Pretest Grade			
2	31	6.65	1.644
3	52	7.02	2.015
4	22	6.09	1.998
5	36	7.31	1.939
Posttest Grade			
2	31	8.90	3.3
3	52	8.92	2.764
4	22	8.09	2.114
5	36	7.69	1.802

A two factor analysis of variance with repeated measures for the pretest to posttest by grade level indicated a significant difference between pretest and posttest scores with a significant interaction between the grade levels and test scores (Table 10). This difference was due to fifth graders because they had the highest pretest score but the lowest posttest

score. The rate of change from pretest to posttest knowledge scores for fifth grade resulted in an interaction with all other grade levels and their rate of change in scores (Figure 3).

Table 10. Two factor ANOVA with repeated measures pretest to posttest of the knowledge section of the questionnaire for students participating in the *Health and Nutrition from the Garden* study by grade level.

Source of Variation	df	SS	MS	F	Sig.
Pretest to Posttest	1	172.04	172.04	42.74	0.000*
Interaction of Grade and Pre/Post	3	37.270	12.420	3.090	0.029*
Error (attitude)	137	551.51	4.03		
Grade	3	26.94	8.98	1.41	0.244
Error	137	875.89	6.39		

* Significant at the 0.05 level.

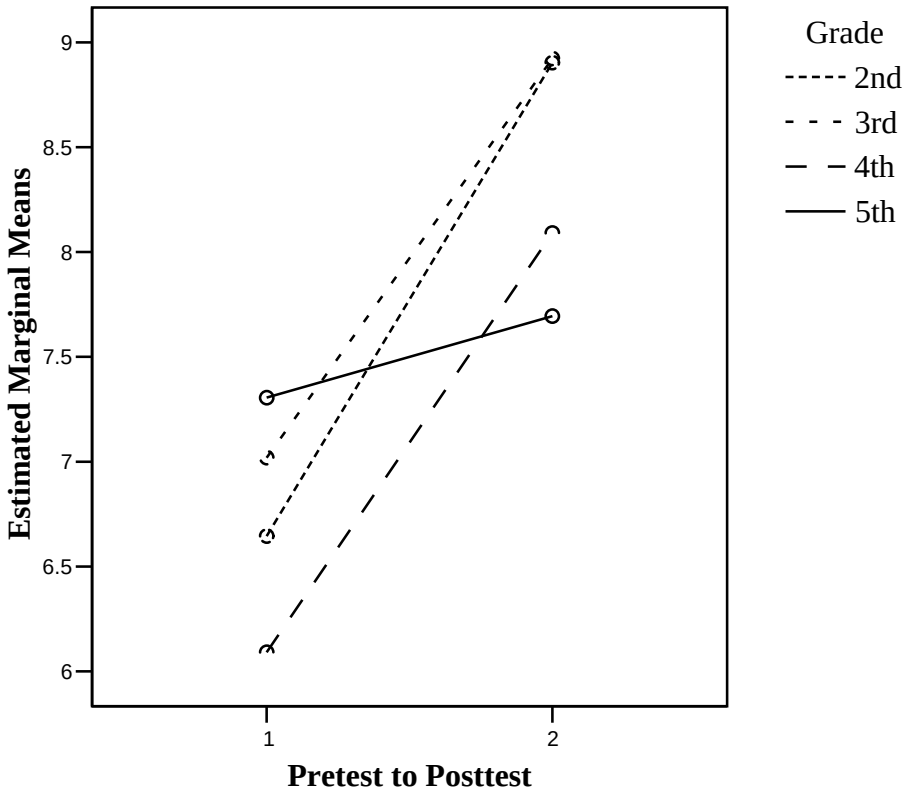

Figure 3. Interaction between the pretest to posttest scores of the knowledge section of the questionnaire for the students participating in the *Health and Nutrition from the Garden* study by grade level.

School

The descriptive statistics for knowledge by school indicated that Mims elementary had an increase of 4.59 points from pretest to posttest, Salinas had an increase of 2.75 points, Gonzales had an increase of 0.73 points, and McAuliffe had a decrease of 0.01 points in their scores (Table 11).

Table 11. Descriptive statistics of knowledge scores pretest and posttest and by school for the *Health and Nutrition from the Garden* study.

School	Number of Cases	Mean Score	Standard Deviation
Pretest			
School			
Mims	37	7.22	1.652
Salinas	12	6.58	1.505
McAuliffe	58	6.79	2.007
Gonzales	34	6.71	2.250
Posttest			
School			
Mims	37	11.31	1.050
Salinas	12	9.33	1.775
McAuliffe	58	6.78	1.665
Gonzales	34	7.44	1.812

A two factor analysis of variance with repeated measures of the pretest to posttest by school indicated a significant difference between pretest and posttest scores and a significant interaction affect between schools (Table 12). The rate of change from the pretest to posttest for the schools was different enough for there to be a significant interaction between the

schools. Due to the different rates of change between the schools, slopes were significantly different (Figure 4).

Table 12. Two factor ANOVA with repeated measures pretest to posttest of the knowledge section of the questionnaire for students participating in the *Health and Nutrition from the Garden* study by school.

Source of Variation	df	SS	MS	F	Sig.
Pretest to Posttest	1	207.01	207.01	86.89	0.000*
Interaction of School and Pre/Post	3	262.390	87.460	36.710	0.000*
Error (attitude)	137	326.39	2.38		
School	3	368.64	122.88	31.51	0.000*
Error	137	534.19	3.90		

*Significant at the 0.05 level.

Table 12 also indicated a significant difference in scores between schools. An LSD post hoc test was administered to find which schools were significantly different. Statistically significant differences were found between Mims and Salinas ($p=0.001$), Mims and McAuliffe ($p<0.001$), Mims and Gonzales ($p<0.000$), and Salinas and McAuliffe ($p=0.001$).

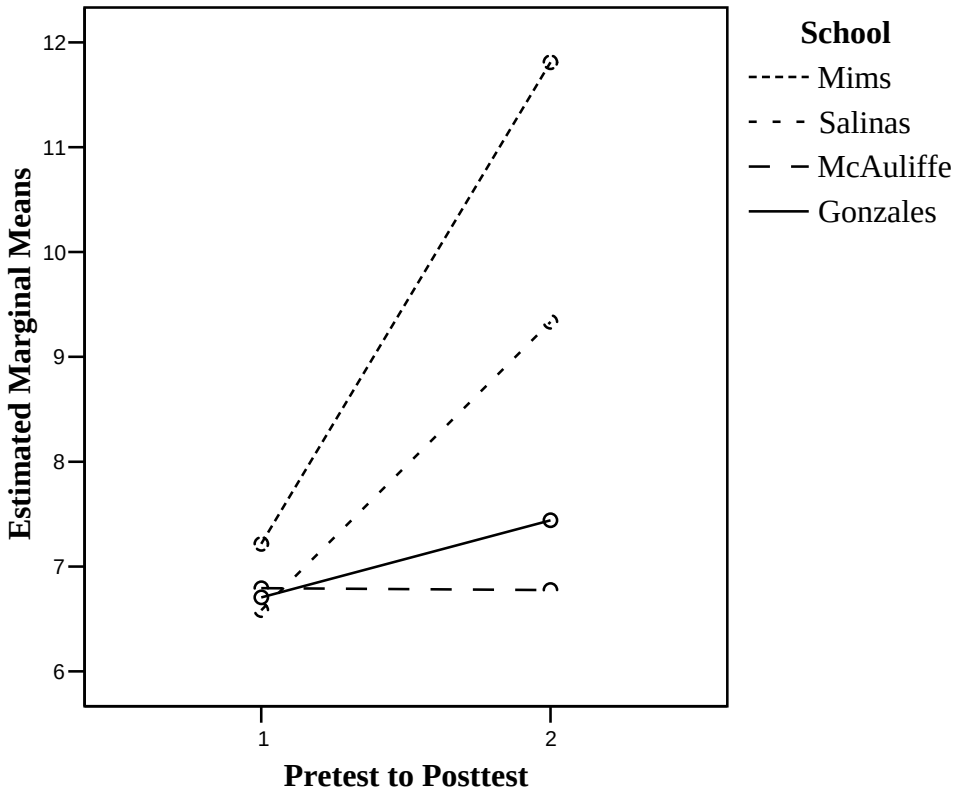

Figure 4. Interaction between the pretest to posttest scores of the knowledge section of the questionnaire for the students participating in the *Health and Nutrition from the Garden* study by school.

Fruit and Vegetable Attitude Section

Pretest and posttest scores of the fruit and vegetable attitude section were compared using a paired t-test; the analysis revealed a statistically significant increase from pretest to posttest scores (Table 13). The results indicated a positive change in attitudes regarding fruits and vegetables after participating in gardening and the *Health and Nutrition from the Garden* curriculum (Genzer et at., 2001). Based on this finding, additional analyses were done to investigate more closely the differences between pretest and posttest nutritional attitude scores.

Table 13. Paired t-test comparing the pretest and posttest nutritional fruit and vegetable attitude scores of students participating in the *Health and Nutrition from the Garden* study.

Group	Number of Cases	Mean Score[z]	Standard Deviation	df	t	Sig (2-tailed)
Pretest	141	11.96	3.619	140	-2.5	0.014*
Posttest	141	12.67	4.112	140		

[z] Scores range from 0.000 to 20.000.

* Significant at the 0.05 level.

Two factor ANOVAs with repeated measures (pretest and posttest) were performed to determine 1) if there were significant differences in fruit and vegetable pretest to posttest attitude scores, 2) if there were significant differences between or among scores when participants were categorized by gender, ethnicity, grade level, and school, and 3) if there were interactions between the pretest to posttest scores and the variables gender, ethnicity, grade level, or school.

Gender

The descriptive statistics (Table 14) for the pretest to posttest scores by gender indicated that females scored higher than males on both the pretest and posttest, 1.18 and 0.54 points, respectively.

Table 14. Descriptive statistics of fruit and vegetable attitude scores pretest and posttest and by gender for the *Health and Nutrition from the Garden* study.

Gender	Number of Cases	Mean Score	Standard Deviation
Pretest			
Female	77	12.49	3.327
Male	64	11.31	3.87
Posttest			
Female	77	12.92	3.655
Male	64	12.38	4.614

A two factor analysis of variance with repeated measures for the pretest to posttest by gender indicated a significant difference between pretest and posttest scores (Table 15). However, there was not a significant difference between scores of male and female students on the attitude section of the survey. This means that male and female scores improved similarly from pretest to posttest1.07 points and 0.43 points, respectively; thus, their rate of change was similar. Because of the similar change in scores there was no interaction between the pretest/posttest change and gender, meaning their slopes were not significantly different (Figure 5).

Table 15. Two factor ANOVA with repeated measures pretest to posttest of the attitude section of the questionnaire for students participating in the *Health and Nutrition from the Garden* study by gender.

Source of Variation	df	SS	MS	F	Sig.
Pretest to Posttest	1	38.85	38.85	6.72	0.011*
Interaction of Gender and Pre/Post	1	7.02	7.02	1.22	0.272
Error (attitude)	139	803.3	5.78		
Gender	1	52.19	52.19	2.17	0.143
Error	139	3338.23	24.02		

* Significant at the 0.05 level.

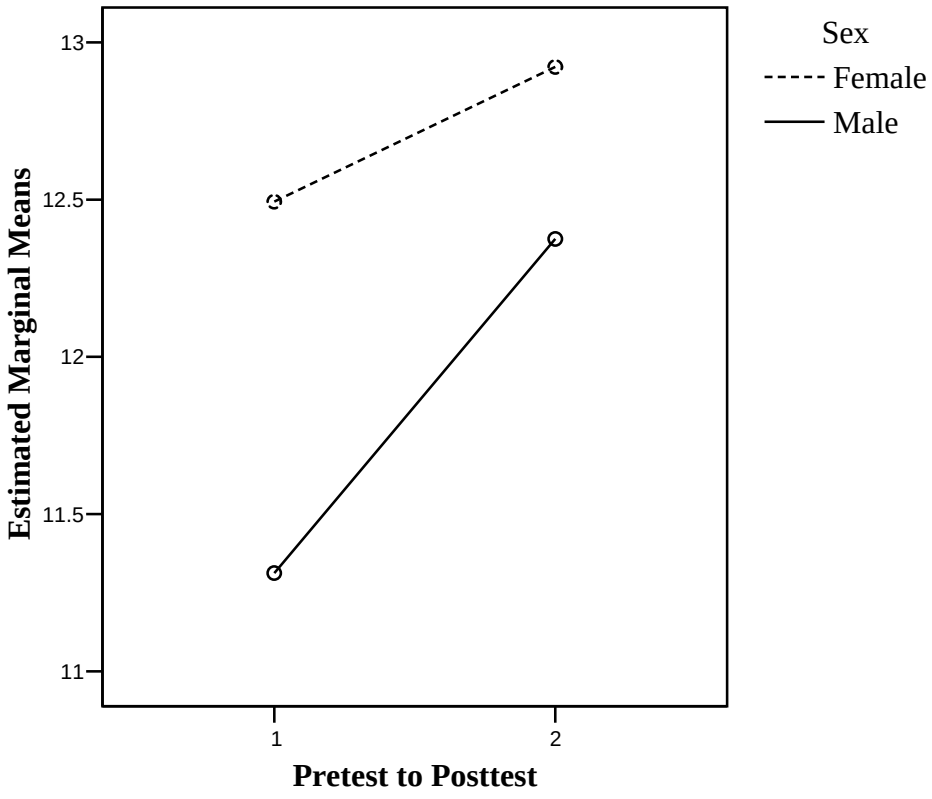

Figure 5. Interaction between the pretest to posttest scores of the fruit and vegetable attitude section of the questionnaire for the students participating in the *Health and Nutrition from the Garden* study by gender.

Ethnicity

The descriptive statistics for the pretest to posttest scores for ethnicity indicated an increase in pretest to posttest scores for Hispanic participants of 0.76 points, an increase for the White participants of 1.31 points and a 0.25 point increase for all other ethnicities. The Black students had a decrease of 1.6 points from pretest to posttest (Table 16).

Table 16. Descriptive statistics of fruit and vegetable attitude scores pretest and posttest and by ethnicity for the *Health and Nutrition from the Garden* study.

Ethnicity	Number of Cases	Mean Score	Standard Deviation
Pretest			
Hispanic	119	11.97	3.619
Black	5	13	4.637
White	13	12.23	3.059
Other	4	9.5	4.435
Posttest			
Hispanic	119	12.73	4.242
Black	5	11.4	3.782
White	13	13.54	3.099
Other	4	9.75	2.5

Because of the small number of participants that were White, Black, or Other, there was insufficient statistical power to detect differences, therefore, only descriptive statistics were used. There was an interaction between the pretest to posttest scores, but this interaction was due to the decrease in attitude scores pretest to posttest for the Black population. For all other ethnicities, Hispanic, White, and Other, the rate of change was similar, meaning their slopes were not significantly different (Figure 6).

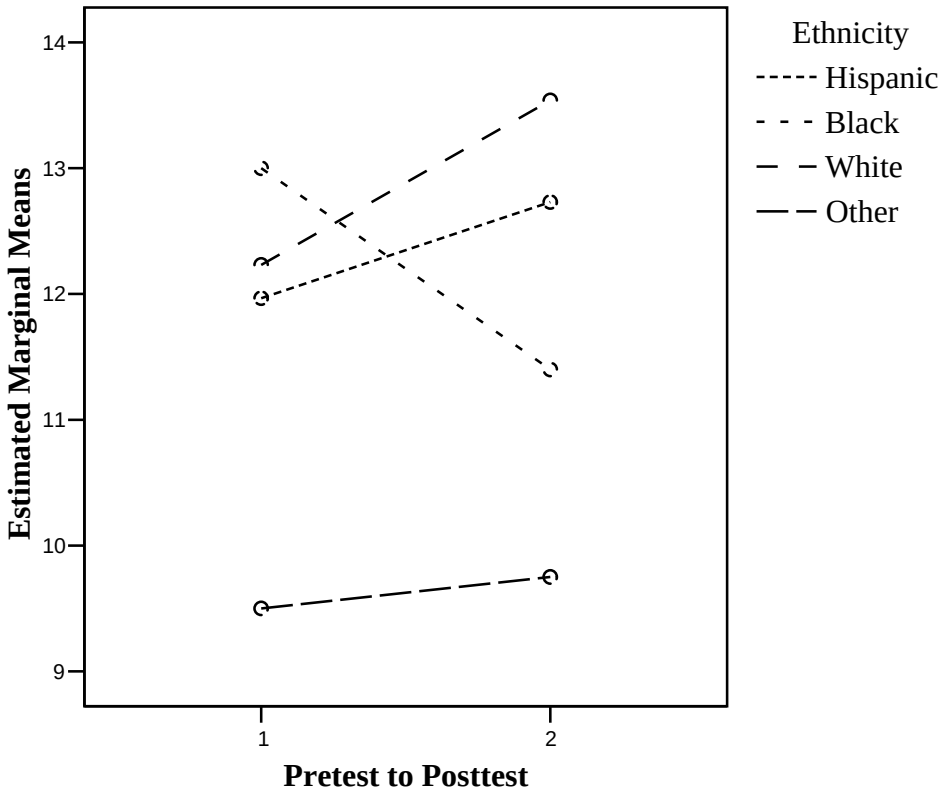

Figure 6. Interaction between the pretest to posttest scores of the fruit and vegetable attitude section of the questionnaire for the students participating in the *Health and Nutrition from the Garden* study by ethnicity.

Grade Level

The descriptive statistics for the pretest to posttest scores for grade level indicated that the second grade students had the greatest increase in pretest to posttest scores of all grade levels. Second graders increased their attitude scores by 1.42 points, while fourth grade increased by 0.77 points, and third and fifth grade increased by less than 0.5 points (Table 17).

Table 17. Descriptive statistics of fruit and vegetable attitude scores pretest and posttest and by grade level for the *Health and Nutrition from the Garden* study.

Grade	Number of Cases	Mean Score	Standard Deviation
Pretest			
Grade			
2	31	13.48	3.244
3	52	12.52	3.578
4	22	10.73	3.467
5	36	10.58	3.475
Posttest			
Grade			
2	31	14.9	3.927
3	52	12.98	3.801
4	22	11.5	3.556
5	36	11.03	4.192

A two factor analysis of variance with repeated measures for the pretest to posttest by grade level indicated a significant difference between pretest and posttest scores (Table 18). The rate of change for each grade level was similar between the pretest and posttest scores; hence the difference was not significant. There was no interaction between the pretest/posttest change and grade level (Figure 3).

Table 18. Two factor ANOVA with repeated measures pretest to posttest of the attitude section of the questionnaire for students participating in the *Health and Nutrition from the Garden* study by grade level.

Source of Variation	df	SS	MS	F	Sig.
Pretest to Posttest	1	38.48	38.48	6.59	0.011*
Interaction of Grade Level and Pre/Post	3	10.71	3.57	0.612	0.608
Error (attitude)	137	799.61	5.84		
Grade Level	3	466.02	155.34	7.28	0.000*
Error	137	2924.39	21.35		

* Significant at the 0.05 level.

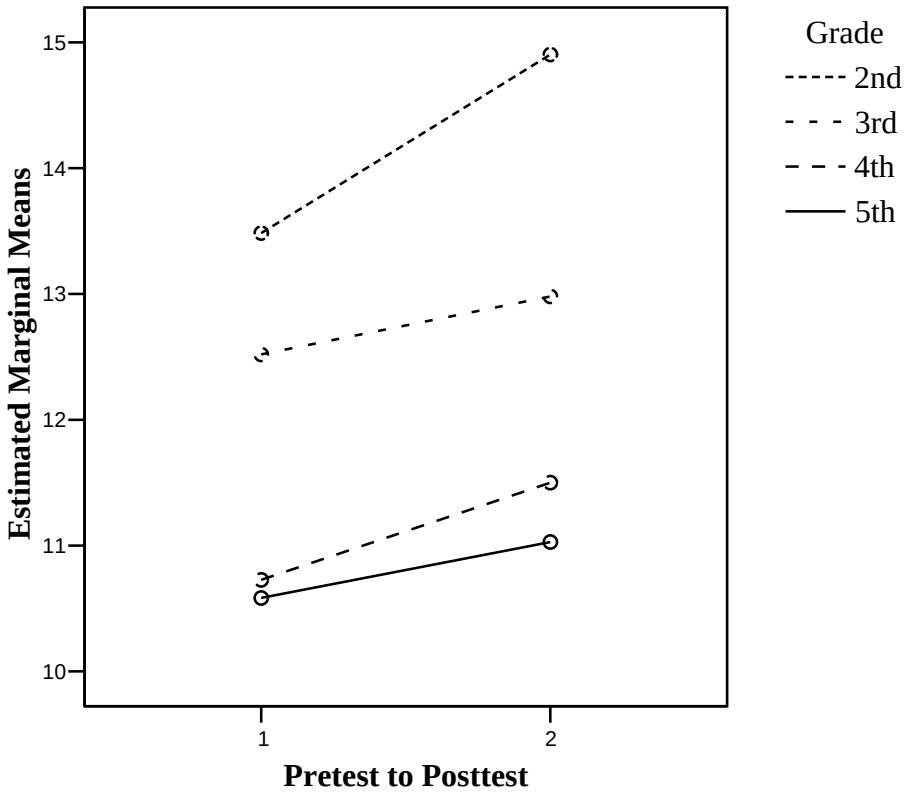

Figure 7. Interaction between the pretest to posttest scores of the fruit and vegetable attitude section of the questionnaire for the students participating in the *Health and Nutrition from the Garden* study by grade level.

There were significant differences between the grade levels (Table 18). This is apparent from the distance between the graphed lines for the test scores of each grade level (Figure 7). An LSD post hoc test was administered to find which grade levels were significantly different. Statistically significant differences were found between grades second and fourth (p=0.001), second and fifth (p=0.000), and third and fifth (p=0.007).

School

The descriptive statistics for attitudes by schools indicated a decrease in pretest to posttest scores for McAuliffe elementary and Gonzales elementary, -0.39 and -0.12 points, respectively. Mims elementary increased their posttest scores by 3.02 points and Salinas by 1.34 points (Table 19).

Table 19. Descriptive statistics of fruit and vegetable attitude scores pretest and posttest and by school for the *Health and Nutrition from the Garden* study.

School	Number of Cases	Mean Score	Standard Deviation
Pretest			
School			
Mims	37	13.14	3.225
Salinas	12	11.08	4.116
McAuliffe	58	12.41	3.464
Gonzales	34	10.21	3.514
Posttest			
School			
Mims	37	16.16	2.882
Salinas	12	12.42	4.4
McAuliffe	58	12.02	3.818
Gonzales	34	10.09	3.118

A two factor analysis with repeated measures for the pretest to posttest by school indicated a significant difference between pretest and posttest scores (Table 20). The interaction between the schools was also significantly different, meaning there was interaction between the pretest/posttest change and school (Figure 8). This resulted because both McAuliffe and Gonzales Elementary schools' attitude scores decreased from pretest to posttest.

Table 20. Two factor ANOVA with repeated measures pretest to posttest of the attitude section of the questionnaire for students participating in the *Health and Nutrition from the Garden* study by school.

Source of Variation	df	SS	MS	F	Sig.
Pretest to Posttest	1	47.11	47.12	9.76	0.002*
Interaction of School and Pre/Post	3	148.80	49.60	10.27	0.000*
Error (attitude)	137	661.52	4.83		
School	3	731.41	243.80	12.56	0.000*
Error	137	2659.01	19.41		

* Significant at the 0.05 level.

There were also significant differences between the schools, which is apparent from the distance between the graphed lines for the pretest to posttest scores for each school (Figure 8). An LSD post hoc test was administered to find which schools were significantly different. Statistically significant differences were found between Mims and Salinas (p=0.006), Mims and McAuliffe (p=0.000), Mims and Gonzales (p=0.000), and McAuliffe and Gonzales (p=0.003).

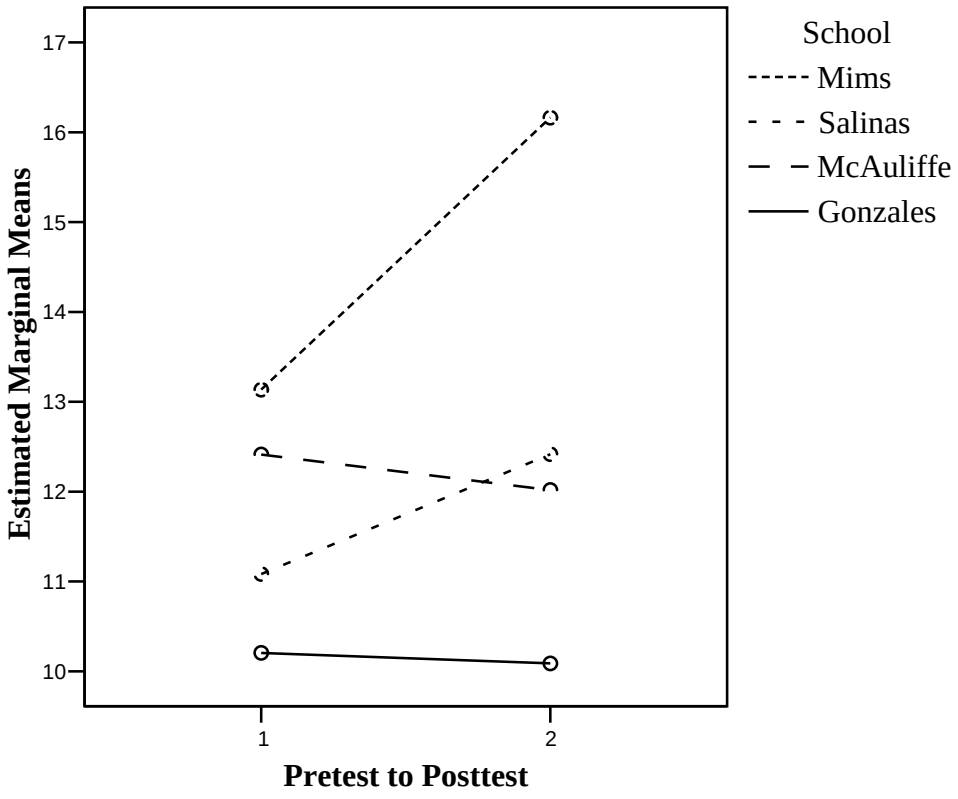

Figure 8. Interaction between the pretest to posttest scores of the fruit and vegetable attitude section of the questionnaire for the students participating in the *Health and Nutrition from the Garden* study by school

Snack Section

Pretest and posttest scores of the snack preference section were compared and a paired t- test analysis revealed a statistically significant increase from pretest to posttest scores (Table 21). The results indicated a positive change in preferences for fruits and vegetables after participating in gardening and the *Health and Nutrition from the Garden* curriculum (Genzer et al., 2001). Due to this finding, additional analyses were done to investigate more closely the differences between pretest and posttest scores.

Table 21. Paired t-test comparing the pretest and posttest fruit and vegetable snack preference scores of students participating in the *Health and Nutrition from the Garden* study.

Group	Number of Cases	Mean Score[z]	Standard Deviation	df	t	Sig (2-tailed)
Pretest	141	4.38	2.537	140	-7.059	0.000*
Posttest	141	6.4	3.064	140		

[z] Scores range from 0.00 to 20.00.

* Significant at the 0.05 level.

Two factor ANOVAs with repeated measures (pretest and posttest) were performed to determine 1) if there were significant differences in fruit and vegetable pretest to posttest scores, 2) if there were significant differences between or among scores when participants were categorized by gender, ethnicity, grade level, and school, and 3) if there were interactions between the pretest to posttest scores and the variables gender, ethnicity, grade level, or school.

Gender

The descriptive statistics for the fruit and vegetable snack preference section by gender indicated that the male students had a greater increase in pretest to posttest scores for snack preference than did the females. The males increased their scores by 2.06 points and the females increased their scores by 2.00 points (Table 22).

Table 22. Descriptive statistics of fruit and vegetable snack preference scores pretest and posttest and by gender for the *Health and Nutrition from the Garden* study.

Gender	Number of Cases	Mean Score	Standard Deviation
Pretest			
Female	77	4.78	2.573
Male	64	3.89	2.424
Posttest			
Female	77	6.78	2.905
Male	64	5.96	3.209

A two factor analysis of variance with repeated measures for the pretest to posttest by gender indicated a significant difference between pretest and posttest scores (Table 23). There was no interaction between the pretest/posttest change and gender, because the rate of change for males and females was similar between pretest to posttest scores (Figure 9). There was a significant difference between the genders, meaning overall, the females scored significantly higher than the male students.

Table 23. Two factor ANOVA with repeated measures pretest to posttest of the snack preference section of the questionnaire for students participating in the *Health and Nutrition from the Garden* study by gender.

Source of Variation	df	SS	MS	F	Sig.
Pretest to Posttest	1	288.41	288.41	49.20	0.000*
Interaction of Gender and Pre/Post	1	0.068	0.068	0.012	0.914
Error (attitude)	139	814.88	5.86		
Gender	1	51.38	51.38	5.30	0.023*
Error	139	1348.71	9.70		

*Significant at the 0.05 level.

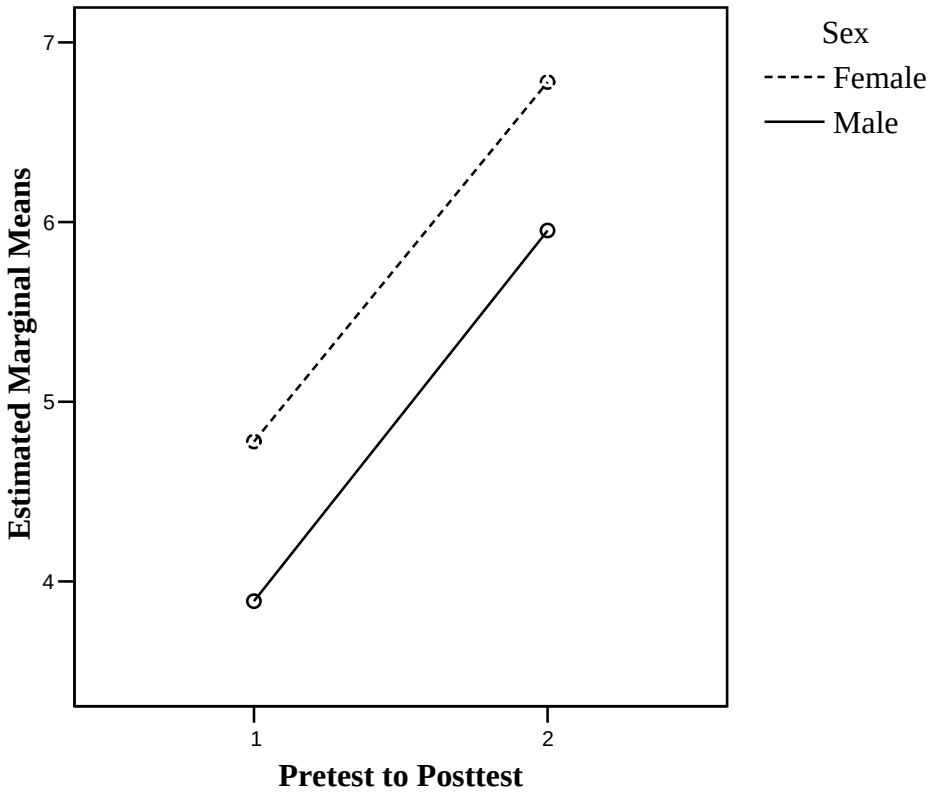

Figure 9. Interaction between the pretest to posttest scores of the snack preference section of the questionnaire for the students participating in the *Health and Nutrition from the Garden* study by gender.

Ethnicity

The descriptive statistics for the fruit and vegetable snack preference section by ethnicity indicated that the White participants had the greatest increase in pretest to posttest scores for the snack preference section with an increase of 3.31 points followed by the Black students who increased their scores by 3.00 points, then all other ethnicities with an increase of 2.25 points, and last, the Hispanic students had the least increase of 1.84 points (Table 24).

Table 24. Descriptive statistics of fruit and vegetable snack preference scores pretest and posttest and by ethnicity for the *Health and Nutrition from the Garden* study.

Ethnicity	Number of Cases	Mean Score	Standard Deviation
Pretest			
Hispanic	119	4.51	2.62
Black	5	3.4	3.362
White	13	4.23	1.092
Other	4	2	0.816
Posttest			
Hispanic	119	6.35	3.093
Black	5	6.4	3.782
White	13	7.54	2.634
Other	4	4.25	1.708

Because of the small number of participants that were White, Black, or Other, there is not enough power to detect differences, therefore, only descriptive statistics were used. There was an interaction between the pretest to posttest scores. The Hispanic participants had the highest pretest snack preference score, but had the least improvement causing their scores to overlap with the Black students' and White students' pretest to posttest scores (Figure 10).

Grade Level

The descriptive statistics for the fruit and vegetable snack preference section by grade level indicated that the greatest increase in pretest to posttest scores was for fourth grade, who had an increase of 3.00 points. Second and third grades were very similar with an increase of 2.48 and 2.50 points, respectively. The smallest increase was for the fifth grade students who only had an increase of 0.36 points (Table 25).

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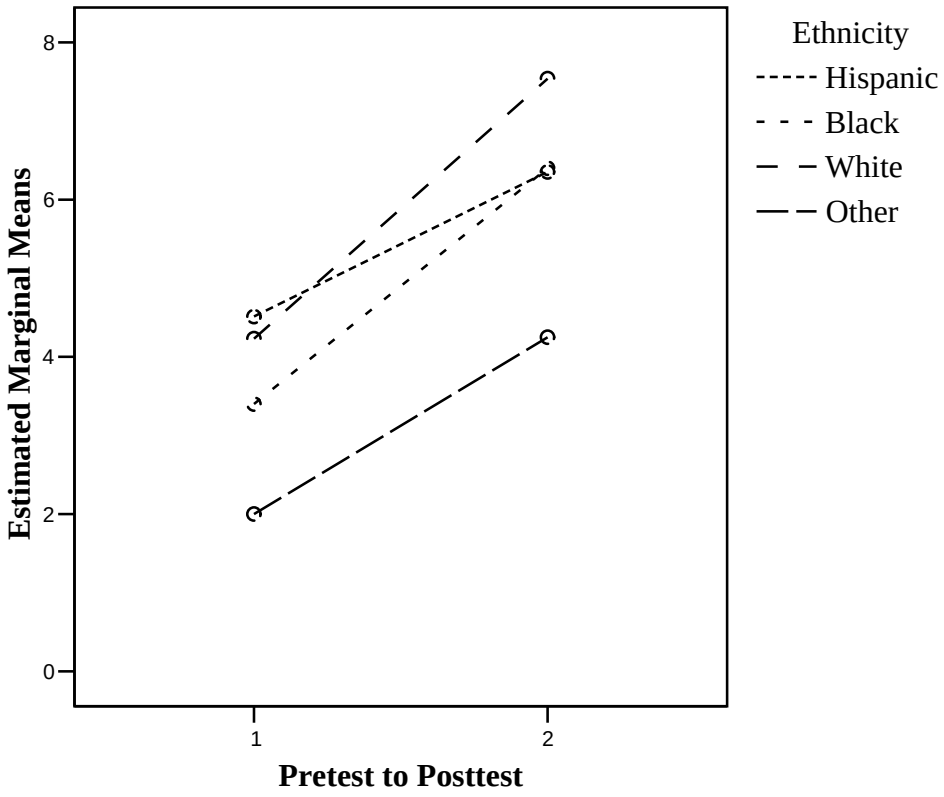

Figure 10. Interaction between the pretest to posttest scores of the snack preference section of the questionnaire for the students participating in the *Health and Nutrition from the Garden* study by ethnicity

Table 25. Descriptive statistics of fruit and vegetable snack preference scores pretest and posttest and by grade level for the *Health and Nutrition from the Garden* study.

Grade	Number of Cases	Mean Score	Standard Deviation
Pretest Grade			
2	31	4.55	2.978
3	52	4.63	2.409
4	22	3.18	1.868
5	36	4.58	2.545
Posttest Grade			
2	31	7.03	2.994
3	52	7.13	2.744
4	22	6.18	3.172
5	36	4.94	3.079

A two factor analysis of variance with repeated measures for the pretest to posttest by grade level indicated a significant difference between pretest and posttest scores (Table 26). The rate of change for each grade level was also significantly different (Figure 11). This was due to the fifth grade pretest scores being the highest of all grade levels and the posttest scores showing the least improvement and being the lowest, therefore the lines between the grade levels crossed showing a significant difference between the grade levels.

Table 26. Two factor ANOVA with repeated measures pretest to posttest of the snack preference section of the questionnaire for students participating in the *Health and Nutrition from the Garden* study by grade level.

Source of Variation	df	SS	MS	F	Sig.
Pretest to Posttest	1	279.18	279.18	51.30	0.000*
Interaction of Grade Level and Pre/Post	3	69.420	23.140	4.250	0.007*
Error (attitude)	137	745.52	5.44		
Grade Level	3	85.67	28.56	2.98	0.034*
Error	137	1314.42	9.60		

* Significant at the 0.05 level.

There were also significant differences between the grade levels (Table 26). An LSD post hoc test was administered to find which grade levels were significantly different. Statistically significant differences were found between the third and fourth grades ($p=0.033$) and third and fifth grades ($p=0.020$). This can be seen from the graphed lines for each grade level change from pretest to posttest scores (Figure 7).

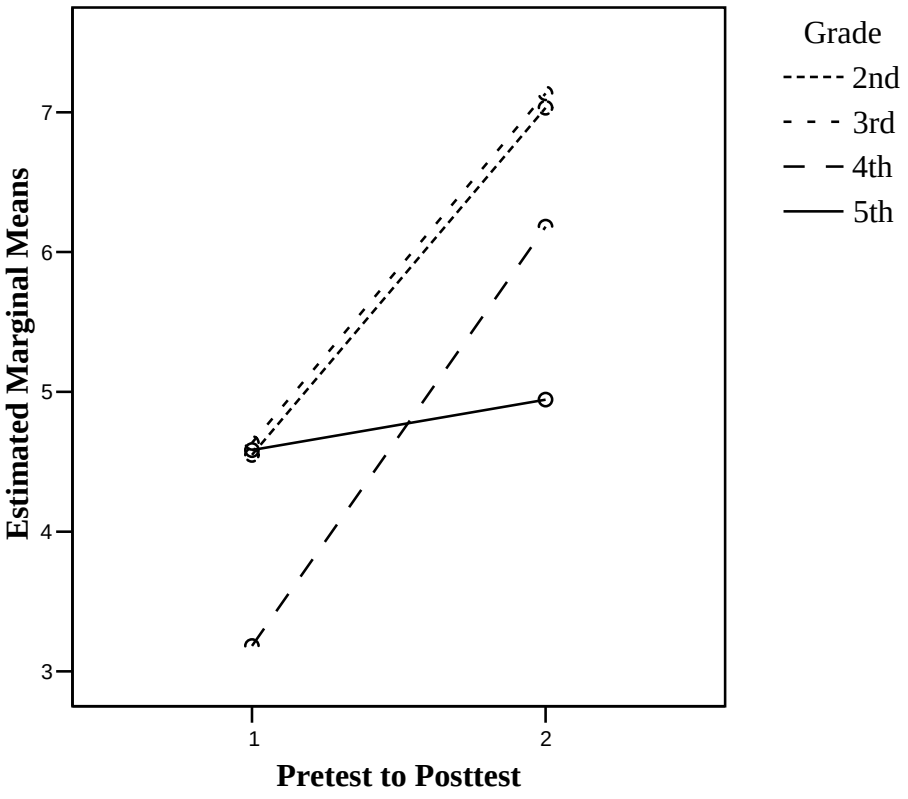

Figure 11. Interaction between the pretest to posttest scores of the snack preference section of the questionnaire for the students participating in the *Health and Nutrition from the Garden* study by grade level.

School

The descriptive statistics for snack preference by school indicated that Salinas elementary had the greatest improvement in pretest to posttest scores and Gonzales had the least improvement. Salinas improved by 3.75 points, Mims improved by 3.03 points, McAuliffe improved by 1.79 points, and Gonzales improved by only 0.74 points (Table 27).

Table 27. Descriptive statistics of fruit and vegetable snack preference scores pretest and posttest and by school for the *Health and Nutrition from the Garden* study.

School	Number of Cases	Mean Score	Standard Deviation
Pretest			
School			
Mims	37	5.350	2.312
Salinas	12	3.830	3.010
McAuliffe	58	4.190	2.578
Gonzales	34	3.820	2.329
Posttest			
School			
Mims	37	8.380	1.754
Salinas	12	7.580	3.260
McAuliffe	58	5.980	3.092
Gonzales	34	4.560	2.776

A two factor analysis of variance with repeated measures for the pretest to posttest by schools indicated a significant increase between pretest to posttest scores (Table 28). A significant difference was also found for interaction between schools. The rate of change from the pretest to posttest for the schools was different enough for there to be a significant

interaction between the schools (Figure 12). This interaction was due to Salinas elementary having one of the lowest pretest scores but the greatest improvement pretest to posttest.

Table 28. Two factor ANOVA with repeated measures pretest to posttest of the snack preference section of the questionnaire for students participating in the *Health and Nutrition from the Garden* study by school.

Source of Variation	df	SS	MS	F	Sig.
Pretest to Posttest	1	275.74	275.74	50.46	0.000*
Interaction of Gender and Pre/Post	3	66.260	22.090	4.040	0.009*
Error (attitude)	137	748.68	5.47		
School	3	271.83	90.61	11.00	0.000*
Error	137	1128.26	8.26		

* Significant at the 0.05 level.

There were also significant differences between the schools (Table 28). An LSD post hoc test was administered to find which schools were significantly different. Statistically significant differences were found between Gonzales and Mims (p=0.000), Gonzales and Salinas (p=0.028), Gonzales and McAuliffe (p=0.043), and Mims and McAuliffe (p=0.000).

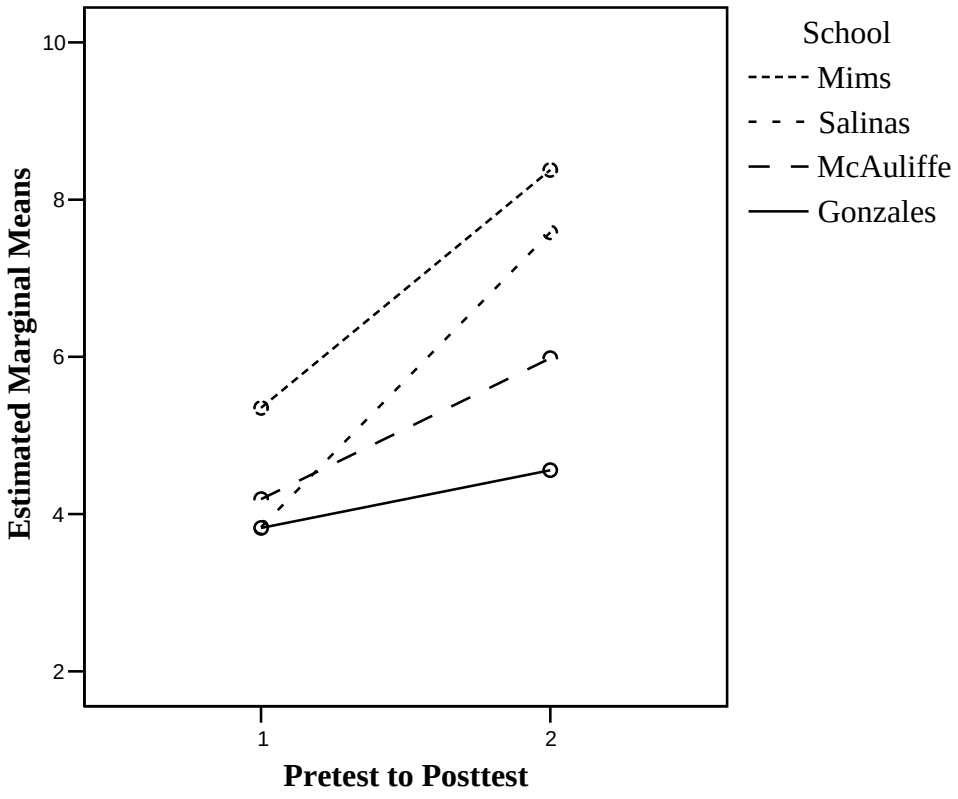

Figure 12. Interaction between the pretest to posttest scores of the snack preference section of the questionnaire for the students participating in the *Health and Nutrition from the Garden* study by school.

Discussion Summary

Elementary students who were taught the *Health and Nutrition from the Garden* curriculum and actively participated in gardening significantly improved their nutritional knowledge. The students who participated in the *Health and Nutrition from the Garden* study also significantly improved their attitudes toward fruits and vegetables and their preferences for choosing a fruit or vegetable snack over a non-healthy snack.

Knowledge Section

The knowledge scores for the students participating in the *Health and Nutrition from the Garden* study increased from pretest to posttest at a statistically significant level of 1.61 points. This indicates an increase in knowledge after having completed the educational curriculum and active participation in gardening. Previous research has also shown an increase in knowledge after an intervention (Howison et al., 1988, Lawatsch, 1990; Domel et al., 1993b; Morris et al., 2002).

A closer examination of where the differences took place or did not take place revealed that there were no significant differences between gender and ethnicity, but there was a significant difference between schools and an interaction between grade levels.

Male and female students had similar knowledge before participating in the *Health and Nutrition from the Garden* study and also had comparable increases after learning the curriculum and gardening. As a result there was no difference or interaction

between male and female scores before or after the intervention. Therefore, gardening and the curriculum had the same positive affect on male and female elementary students.

All ethnicities including Hispanic, Black, White, and all others, also increased their knowledge scores after participating in the *Health and Nutrition from the Garden* study. There was no interaction between the pretest to posttest change and ethnicity; meaning, all ethnicities had pretest scores that were similar and all had similar levels of improvement. This also means that the curriculum and gardening experience had comparable effects on the different ethnicities.

There was not a significant difference between grade levels, but there was an interaction between the pretest/posttest change and grade levels. Fifth grade students had the highest pretest scores of all grade levels, but the least improvement. Second graders had one of the lowest pretest scores, but ended up with one of the highest posttest scores. The *Health and Nutrition from the Garden* curriculum combined with gardening had more of an effect on the younger students, meaning the activities may be better geared toward younger students for knowledge purposes. These findings agree with the research conducted by Carter (2002) and Baranowski et al. (1997) stating that strategies should be aimed at younger children and not adolescents.

There were many significant differences between schools. There was significant interaction between schools due to Salinas, McAuliffe, and Gonzales having pretest scores within 0.13 points of each other and all of them improving at different levels. There were also significant differences between the schools. Mims elementary had higher pretest and posttest scores than all other elementary schools causing the

differences to be significant. Salinas had much greater improvement pretest to posttest than Gonzales, a 2.02 point difference, causing the difference to be significant. The sample from Mims elementary, which had the greatest pretest to posttest increase, was comprised of second and third graders. McAuliffe elementary had a decrease in pretest to posttest scores and had a fairly even distribution of grade levels. Since the greatest increase in pretest to posttest knowledge scores was seen in second graders, this may help explain the reason Mims elementary did better than the others. Again, second graders started with lower scores and had greater improvement.

Attitude Section

The fruit and vegetable attitude scores for the students participating in the *Health and Nutrition from the Garden* study increased from pretest to posttest at a statistically significant level of 0.71 points. This indicates an increase in fruit and vegetable attitudes after having completed the educational curriculum and active participation in gardening. An increased attitude toward fruits and vegetables after an intervention has been found by previous research (Lawatsch, 1990; Byrd-Bredbenner et al., 1993; Lineberger and Zajicek, 2000).

A closer examination of where the differences took place or did not take place revealed that there was not a significant difference between genders, but there were significant differences between grade levels and schools and an interaction between ethnicities.

Male and female students had similar fruit and vegetable attitudes before participating in the *Health and Nutrition from the Garden* study and also had comparable increases after learning the curriculum and gardening. This resulted in there not being a difference or an interaction between male and female scores before or after the intervention. Therefore, gardening and the *Health and Nutrition from the Garden* curriculum had the same positive affect on male and female elementary students' fruit and vegetable attitudes.

There was an interaction between the pretest to posttest fruit and vegetable attitude scores for ethnicity, but this interaction was due to the decrease in attitude scores for the Black population. The Hispanic, White and other ethnicities all had similar increases in their fruit and vegetable attitude scores, meaning the *Health and Nutrition from the Garden* curriculum combined with gardening had comparable positive effects on the Hispanic, White and other ethnicities fruit and vegetable attitudes.

There was not an interaction between the different grade levels; however, there was a significant difference between their fruit and vegetable attitude scores. This means that each grade level had comparable improvement from the pretest to the posttest. In other words, the slopes of their lines pretest/posttest change was similar for each grade. There were however significant differences between the grades because of the difference between their pretest and posttest scores. Second graders scored significantly higher than fourth and fifth graders. Third grade students also scored significantly higher than fifth grade. Second grade students had high preexisting attitudes towards fruits and vegetables, and they also had the most improvement after the

intervention, whereas fifth grade had the lowest pretest scores and the least improvement. These results show that *Health and Nutrition from the Garden* curriculum combined with gardening may also have greater effect on younger elementary student attitudes toward fruits and vegetables.

Once again, there were many significant differences between schools. There was significant interaction between schools due to McAuliffe elementary having a decrease in scores from pretest to posttest. There were also significant differences between the schools. Mims elementary had significantly higher pretest and posttest scores than all other elementary schools causing the differences with all other schools to be significant. McAuliffe and Gonzales were also significantly different from each other, even though they both had a decrease from pretest to posttest. McAuliffe elementary had pretest scores that were 2.2 points higher than Gonzales elementary pretest scores, causing the difference to be significant. The sample from Mims elementary, which had the greatest pretest to posttest increase, was comprised of second and third graders. McAuliffe elementary had a decrease in pretest to posttest scores and had a fairly even distribution of grade levels. Since the greatest increase in pretest to posttest fruit and vegetable attitude scores was seen in second graders, this may help explain the reason Mims elementary did better than the others.

Preference Section

The fruit and vegetable preference scores for the students participating in the *Health and Nutrition from the Garden* study increased from pretest to posttest at a

statistically significant level of 2.02 points. This indicates an increase in choosing a fruit and vegetable snack over a non-healthy snack after having completed the *Health and Nutrition from the Garden* curriculum and active participation in gardening. There have been mixed findings in the research for children's fruit and vegetable preferences after an intervention. An increase in preference for a fruit or vegetable snack has been reported (Domel et al., 1993a, and Lineberger and Zajicek, 2000) and no change in preference after the intervention has also been found.

A closer examination of where the differences took place or did not take place revealed that there were significant differences between genders, grade levels and schools and an interaction between ethnicities.

There were significant differences between the male and female scores for fruit and vegetable snack preferences. The difference between them stemmed from the fact that the female students had higher pretest fruit and vegetable preferences and higher posttest fruit and vegetable preferences. However, their rate of change from pretest to posttest was similar, causing no interaction between the genders. This means that despite the significant difference between the genders, the curriculum and gardening experience had the same effect on both male and female elementary students', the difference is simply that female students started out choosing healthier snacks than the male students. A greater preference for fruits and vegetables by female students has been reported in other research as well (Domel et al., 1993a; Lineberger and Zajicek, 2000).

There was an interaction between the pretest to posttest fruit and vegetable preference scores for ethnicity. This interaction was due to the Hispanic students

having less of an increase from pretest to posttest than the White and Black students. Even though there was an interaction between the ethnicities, they all improved their scores from pretest to posttest, meaning the *Health and Nutrition from the Garden* curriculum combined with gardening did have a positive effect on all ethnicities.

There was an interaction between the grade levels and a significant difference between them for the fruit and vegetable preference section of the instrument. The interaction was caused by the fifth grade students having less improvement than the other grade levels. Second, third, and fifth grade had pretest scores that were within 0.08 points of each other, but the fifth grade students only improved by 0.36 points while all the other grade levels improved by at least 2.48 points, which caused the interaction between the grade levels. There was also a significant difference between the pretest and posttest preference scores for the grade levels. For the preference section, the third grade students had the highest pretest and posttest scores which caused them to be significantly different from fourth grade that had great improvement, but a low pretest score and fifth grade, that had very little improvement. Once again, the intervention may be best targeted at younger elementary students for greater effect. Previous research has reported greater improvement in fruit and vegetable snack preferences with younger children as well (Lineberger and Zajicek, 2000) and more overall success with nutrition interventions in younger children (Story, 1999).

There were significant differences between schools as well as interactions between them. The interaction was caused by Salinas elementary having a low pretest score, but the greatest improvement after the intervention. The significant differences

between Gonzales elementary and all other schools were a result of Gonzales elementary having a low pretest score and little improvement after learning the curriculum and gardening. There were also significant differences between Mims elementary and McAuliffe elementary because the distances between both their pretest and posttest scores were so great. This may be a result of the sample from Mims Elementary being comprised of only second grade students, while McAuliffe had a fairly even distribution of all grade levels.

There were significant differences between the male and female scores for fruit and vegetable snack preferences. The difference between them stemmed from the fact that the female students had higher pretest fruit and vegetable preferences and higher posttest fruit and vegetable preferences. However, their rate of change from pretest to posttest was similar, causing no interaction between the genders. This means that despite the significant difference between the genders, the curriculum and gardening experience had the same effect on both male and female elementary students', the difference is simply that female students started out choosing healthier snacks than the male students.

There was an interaction between the pretest to posttest fruit and vegetable preference scores for ethnicity. This interaction was due to the Hispanic students having less of an increase from pretest to posttest than the White and Black students. Even though there was an interaction between the ethnicities, they all improved their scores from pretest to posttest, meaning the *Health and Nutrition from the Garden* curriculum combined with gardening did have a positive effect on all students.

There was an interaction between the grade levels and a significant difference between them for the fruit and vegetable preference section of the instrument. The interaction was caused by the fifth grade students having less improvement than the other grade levels. Second, third, and fifth grade had pretest scores that were within 0.08 points of each other, but the fifth grade students only improved by 0.36 points while all the other grade levels improved by at least 2.48 points, which caused the interaction between the grade levels. There was also a significant difference between the pretest and posttest preference scores for the grade levels. For the preference section, the third grade students had the highest pretest and posttest scores which caused them to be significantly different from fourth grade that had great improvement, but a low pretest score and fifth grade, that had very little improvement. Once again, the intervention may be best targeted at younger elementary students for greater effect.

There were significant differences between schools as well as interactions between them. The interaction was caused by Salinas elementary having a low pretest score, but the greatest improvement after the intervention. The significant differences between Gonzales elementary and all other schools were a result of Gonzales elementary having a low pretest score and little improvement after learning the curriculum and gardening. There were also significant differences between Mims elementary and McAuliffe elementary because the distances between both their pretest and posttest scores were so great. This may be a result of the sample from Mims Elementary being comprised of only second grade students, while McAuliffe had a fairly even distribution of all grade levels.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter contains a summary of chapters I through IV. It also includes conclusions drawn from the analyses of the research data. This chapter will conclude with recommendations for future practice and research.

Summary

Purpose of Study

The purpose of this study was to evaluate whether *Health and Nutrition from the Garden* (Genzer et al., 2001) combined with gardening improved children's attitudes and nutrition preferences for fruits and vegetables and improved their knowledge of nutrition.

The objectives of this study were to:

1. Evaluate the effect of participation in gardening and the *Health and Nutrition from the Garden* curriculum on children's nutritional knowledge.
2. Evaluate the effect of participation in gardening and the *Health and Nutrition from the Garden* curriculum on children's attitudes toward fruits and vegetables.
3. Evaluate the effect of participation in gardening and the *Health and Nutrition from the Garden* curriculum on children's preference for fruits and vegetables.

Review of Literature

A proper diet including fruits and vegetables is very important to the growth and development of children. Children that are undernourished, not consuming the necessary vitamins and minerals, are more likely to get sick (Troccoli, 1993; Symons et al., 1997; Brown, 2002) and have behavior problems (Brown, 2002). The percentage of overweight children ages six to nineteen has increased to approximately thirty percent and the numbers continue to rise (Wang, 2001; Ogden et al., 2002; St-Onge et al., 2003). Overweight and obese children tend to have unfavorable fat storage levels, high blood pressure, hardening of the aorta and coronary arteries, and type 2, adult type, diabetes (Raman, 2002; Weisberg, 2002; Jolliffe, 2004). These diseases that develop in childhood carry over into adulthood and have been linked to adult mortality (Wang, 2001).

In the United States the prevalence of overweight and obesity is greatest among the low income groups (Morton and Guthrie, 1999; Wang, 2001) and unfortunately child and adolescent obesity has been linked to socioeconomic status (Wang, 2001; Raman, 2002). This may be due to low SES groups reporting that they often do not buy fresh fruits and vegetables because they are too expensive (Kirby et al., 1995; Treiman et al., 1996; Morton and Guthrie, 1999). Hispanic children are at an even higher risk for overweight and obesity compared to White children (Wang, 2001).

Food preferences, dietary habits, behavior, and lifestyle choices are all developed and established during childhood (Kirby et al., 1995; Carter, 2002). Therefore,

elementary school may be the best time to promote nutrition education. Nutrition education is able to increase nutritional knowledge and cause a positive attitude change towards healthy eating (Contento et al., 1992). Furthermore, a nutrition lesson combined with gardening increases children's preferences for vegetables and has better long term effects on the students' vegetable preferences (Morris et al., 2002). This is of significance because fruits and vegetables are important to a healthy diet because they contain nutrients that decrease the risk for cardiovascular disease and certain cancers (Domel et al., 1993a; Kirby et al., 1995; Ness and Powles, 1997; Liu et al., 2000; Bazzano et al., 2002; Cullen et al., 2002; Djoussé et al., 2004).

Methodology

The curriculum guide, *Health and Nutrition from the Garden* of the Junior Master Gardener$_{sm}$ Golden Ray Series$_{sm}$ (Genzer et al., 2001) was used for this study. Teachers that attended a six-day workshop presented by the Hidalgo County Texas Cooperative Extension Agents volunteered to implement the curriculum in their classrooms and classroom participation in pretest and posttest questionnaires. There were 141 participants in this study. Only students that completed all of the testing were included in the data and analysis.

Population and Sample

This research was conducted with second through fifth grade students from elementary schools throughout the Rio Grande Valley. The pretest was administered in

August of 2002 and the posttest was administered in March of 2003. The elementary schools that were included were McAuliffe, Mims, Salinas, and Gonzalez. The Rio Grande Valley borders Mexico, and much of the culture is Hispanic. It is also an area of lower socioeconomics with many of the families' incomes near poverty level.

Assessment Tools

The instrument used for this study consisted of three sections. The first section was demographic information that included questions regarding the student's gender, ethnicity, grade level, and school.

The second section, which consisted of two parts, was a modification of Dr. Tom Baranowski's preference questionnaire (Domel et al., 1993b). The first part asked the students to circle an answer for how they felt about a specified fruit or vegetable. Their choices were faces. "I like this a lot," a smiley face, "I like this a little," a neutral face, and "I do not like this," a frowning face. The second part, or the snack section, asked the student to choose between a fruit or vegetable snack and a non-fruit or vegetable snack to be eaten after school.

The third section contained a multiple choice knowledge portion that asked questions regarding food groups, vitamin sources, serving amounts, and nutrition related questions.

Conclusions

An analysis of the internal consistencies for the knowledge portion of the instrument resulted in a reliability coefficient of 0.67, a reliability coefficient of 0.72 for the fruit and vegetable attitude section, and a reliability coefficient of 0.83 for the fruit and vegetable snack preference section, showing this instrument to be a reliable measure (Sapp and Jensen, 1997). Each section of the instrument was analyzed separately to determine differences in attitudes and nutrition preferences for fruits and vegetables and knowledge of nutrition.

The knowledge scores for the students participating in the *Health and Nutrition from the Garden* study significantly increased from pretest to posttest. This indicates that the participants' nutritional knowledge significantly improved after completing the curriculum lessons and the hands-on gardening. The most improvement in nutritional knowledge pretest to posttest was seen for the second grade students. This greater improvement was not a result of the second graders having low pretest scores; their scores were comparable to the other grade levels. The second grade students simply improved more than all other grade levels for the knowledge portion of the instrument.

The fruit and vegetable attitude scores also significantly increased from pretest to posttest for the students that participated in the *Health and Nutrition from the Garden* study, indicating that the participants' attitudes regarding fruits and vegetables improved after completing gardening activities and curriculum lessons. There was a decrease in attitude score pretest to posttest for the Black participants', however this did not have an affect on the overall significance for ethnicity. Once again the younger students had greater improvement than the older students. In the attitude section, the second and third grade

students had greater pretest to posttest improvement than the older, fourth and fifth grade students.

Along with an increase in knowledge and attitudes, there was significant improvement for the fruit and vegetable snack preference section of the instrument. Children that participated in gardening and were taught the hands-on *Health and Nutrition from the Garden* curriculum (Genzer et al., 2001) had improved preferences for fruit and vegetable snacks over non-fruit and vegetable snacks. Female participants had significantly higher fruit and vegetable preferences than male participants, however both genders improved at the same level. There were also differences between grade levels. Grades two, three, and four all increased their preference scores by at least 2.48 points, while fifth grade only improved by 0.36 points.

Recommendations for Practice

The significant improvement for nutritional knowledge scores, fruit and vegetable attitude scores, and fruit and vegetable preferences scores indicate that the hands-on *Health and Nutrition in the Garden* curriculum combined with active participation in gardening can be used to influence elementary children's attitudes and preferences regarding fruits and vegetables and improve their knowledge about nutrition.

The *Health and Nutrition in the Garden* curriculum provided teachers with hands-on lesson plans to guide the teaching of nutrition and health to elementary students. Combined with gardening, the curriculum had positive effects on knowledge, attitudes, and preferences. However, it did not have the same effect on all ages. The

younger students, in second and third grades, had more statistically significant positive outcomes than did the fourth and, especially, fifth grade participants. This may be an indication that the curriculum is not challenging enough for the older students and needs to be made slightly more difficult for them.

Another recommendation when implementing a school program such as *Health and Nutrition in the Garden* is to involve other parties, such as the student's parents and the school cafeteria. Parental involvement could include gardening with their child, or receiving fliers that include recipes and tips about how to consume more fruits and vegetables on a daily basis and nutritional facts. This information would help inform parents of what their child is learning in school giving parents the opportunity to reinforce the information at home. The school cafeteria could get involved by preparing some of the same healthy snacks the children make in the classroom from the recipes in the curriculum. The cafeteria could also use some of the vegetables the children grew in the garden to share with the rest of the school. This would increase pride in the participants gardening accomplishments and may encourage non-participants to try the vegetables.

The positive outcome and increase in nutritional knowledge and positive attitudes towards fruits and vegetables indicate that the *Health and Nutrition from the Garden* curriculum combined with active participation in gardening may be an effective tool to help teachers encourage students towards healthier diets.

Recommendations for Research

Repetition of this study is needed to further investigate the relationship between a nutrition curriculum combined with gardening and nutritional knowledge, attitudes, and preferences. In future studies, researchers should either provide specific instructions for administration of testing to the teachers or personally conduct the administration of the testing to ensure consistency across all classrooms, grades, and schools.

An in depth training session for this curriculum was provided and required for all teachers that volunteered their classes for research. However, there was no follow-up to ensure they implemented the curriculum in the correct manner. Therefore, future researchers need to develop a process to evaluate the implementation of the curriculum to ensure it is standardized.

This research concentrated on assessing the participants' nutritional knowledge, and attitudes and preferences for fruits and vegetables. It did not measure nutritional behavior. Repetition of this study using different evaluation tools that include behavior should be conducted. Examples of possible ways to measure changes in behavior might include having the student actually choose a snack, telling the student they have one dollar and ask them what they would buy with that one dollar, or a 24-hour recall diary repeated several times throughout the study.

In addition, repetition of this study should be conducted using students of different ages and populations. This may include kindergarten and first grade students, junior high, and/or high school aged students. Future research could also look at

different socioeconomic status populations to determine how a gardening curriculum would affect their nutritional knowledge, attitudes, and behavior.

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