THE INFLUENCE OF GARDENING ACTIVITIES ON REPORTS OF HEALTH PROBLEMS, ALLERGIES, AND BODY MASS INDEX

A Dissertation

by

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ABSTRACT

In the last quarter century, the epidemic of overweight and obese Americans has increased strikingly. Obesity is far more perilous than most adults think because it disables and kills by substantially raising the risk of cardiovascular disease, dyslipidemia, hypertension, osteoarthritis, stroke, Type II diabetes, specific forms of cancer and other diseases.

The main purpose of this research was to investigate the influence of gardening activities on activity levels, body mass index (BMI), allergies, and reported overall health of gardeners and non-gardeners. The survey used for this study consisted of five sections, which were modified from previous instruments and, all tested for validity by being shown to a panel of experts. The sample population was drawn from two sources: an online survey, which was posted for four months on social media websites and spread through word of mouth and an identical paper-pencil formatted survey, which was distributed to church, garden, and community service groups within Texas and parts of the Midwest. These paper-pencil survey groups were selected for participation based on their ease of accessibility and interest level in participating in the study. Participants were offered a free packet of wildflower seeds as an incentive to take part in the survey.

Results from this study indicated non-gardeners were less physically active when compared to gardeners. Frequency of gardening did not have a statistically significant impact on gardeners' BMI. There was no difference in BMI between gardeners and non-gardeners. Gardeners indicated having more frequently reoccurring symptoms for "Ear Infection/Ear Ache," "High Cholesterol," "Kidney Stone," "Gallstones," and "Arthritis,"

indicating gardening may being used as a distraction therapy, helping gardeners to cope with pain and remain active when other forms of exercise may not be an option. There was no statistically significant difference in incidence of allergies between gardeners and non-gardeners, and there was a significant difference between annual household income and physical activity/exercise and BMI for gardeners.

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CHAPTER I

INTRODUCTION

In the last quarter century, the epidemic of overweight and obese Americans has increased strikingly. According to the Center for Disease Control (CDC), approximately 34.9% of adults in the United States are obese (CDC, 2014); this is in keeping with *The President's Council on Physical Fitness and Sports* estimating nearly 3 of 5 American adults carry unhealthy or excess weight (Health and Human Services, 2008).

Obesity is far more perilous than most adults think because it disables and kills by substantially raising the risk of cardiovascular disease, cholesterol, hypertension, osteoarthritis, stroke, Type II diabetes, specific forms of cancer and other diseases (CDC, 2007; Weisberg, 2002;). In addition, obesity is associated with increases in all causes of mortality (HHS, 2001; Ogden, 2006; Weisberg, 2002).

The economic consequences of obesity affect both the individual and the nation. In 2008, medical expenses for treating obesity were nearly $147 billion; the medical cost for those people who were obese was $1,429 higher annually when compared to those of normal weight (CDC, 2014). It has been determined that a multitude of factors likely contribute to obesity, one of which is prevalence of physical inactivity (Kopleman, 2000). Therefore, agreement has been reached that weight-management through regular physical activity is one method that can help reduce this epidemic. To promote and maintain health and reduce the incidence of overweight and obese people in society, recommendations have been made suggesting adults engage in physical activity (of low-

moderate intensity) for a minimum of 30-45 minutes, three to five days a week; (Haskell, et al., 2007; HHS, 2001; Nelson et al., 2007; Pate et al., 1995).

Allergy symptoms, such as stuffy, itchy, or runny nose, and watery, itchy eyes, are common in the United States, affecting approximately one-half of the population (Singh et al., 2010). According to American Academy of Allergy, Asthma and Immunology (AAAAI) (2015), worldwide, allergies affect between 10-30% of the population. Studies have found that people with allergy symptoms rate their quality of life lower, have more missed work days, and less productivity at work and school (Bielory et al., 2014).

Asthma is a chronic health problem closely associated with allergies which can cause mental and social problems in addition to physical symptoms (Coban and Aydemir, 2014). About 25 million or 8% of the U.S. population suffered from asthma in 2009, this was an increase from 20 million or 7% in 2001, an estimated 300 million people worldwide suffer from asthma (AAAAI, 2015). In 2010, asthma was linked to 3,404 deaths in the United States; approximately 250,000 people die prematurely each year from asthma (AAAAI, 2015).

People can interact with plants either passively or actively (Zampini, 1994). Active interaction occurs when individuals are directly involved with growing plants (Lewis, 1992). Alternatively, passive interaction occurs when individuals are in the presence of plants, but not actively engaging with them. Passive interaction can occur in two different ways: being in nature and observing nature (Kiyota, 2009). Being in nature includes such things as walking through a tree-filled park or sitting in a garden, while

observing nature can include viewing a small potted plant sitting on a desk at work or viewing nature from a window (Kiyota, 2009; Zampini, 1994). The mere presence of plants was found to improve life satisfaction environmentally, economically, socially, culturally, and physically (Waliczek et al., 1996; Zampini, 1994).

Gardening has long been one of the most common spare-time activities among senior citizens (Hill and Relf, 1982; Sarola, 1994). A survey of one Illinois nursing home found 90% of the residents reported enjoying gardening in the past and is an age-friendly option for improving the quality of life for older adults (Armstrong, 2000; Austin et al., 2006; Milligan el al., 2004; Rothert and Daubert, 1981). Research analyzing leisure activities such as reading, gardening, hunting, and dancing found that while people decrease the amount of time performing leisure activities as they age, gardening is a leisure activity people continue to perform more often later in life (Agahi et al., 2006).

Research comparing gardeners to non-gardeners (Waliczek et al., 2005) determined gardening influences perceptions of life satisfaction such as overall health, and zest for life. Research has shown gardening reduces the stress of a fatigued mind (Kaplan and Kaplan, 1982). In addition, research reports gardening has physical benefits and has been classified as a moderate physical activity (Nykamp, 1999; Taylor, 1990). A recent study determined ten ordinary garden tasks, which included digging, raking, weeding, mulching, hoeing, sowing seed, harvesting, watering, mixing growing medium, and planting transplants were moderate to high intensity physical activities (Park et al., 2014). In addition, gardening is an activity influencing whole body bone mineral density

since it incorporates weight-bearing motions and uses the whole body (Turner et al., 2002).

It is generally accepted that community gardening and growing food for personal use may increase physical activity and benefit individual diets (Burges-Watson and Moore, 2011; Lake and Townshend, 2006). A meta-analysis investigating gardening and vegetable consumption in children found overall knowledge of nutrition increases when children are exposed to a nutrition education program; however, when children were exposed to gardening programs, their vegetable and fruit consumption increased (Langellotto and Gupta, 2012). Another study on community gardeners found families gardening increased their vegetable and fruit consumption, with adults increasing their consumption four-fold and children increasing their vegetable and fruit consumption three-fold (Carney et al., 2011).

Statement of Research Problem

More than one-third of U.S. adults are obese. Obesity is a problem that transcends gender, culture, age, and socio-economic status. Since the beginning of the 1990's there has been a dramatic increase in obesity in the United States (CDC, 2014). Additionally, allergy symptoms such as stuffy, itchy, or runny nose, and watery, itchy eyes, are common in the United States, affecting approximately one-half of the population (Singh et al., 2010) and is closely associated with asthma, which kills approximately 250,000 people prematurely each year (AAAAI, 2015).

Statement of Purpose

The main purpose of this research was to investigate the influence of gardening activities on activity levels, body mass index (BMI), allergies, and reported overall health in gardeners and non-gardeners.

The main objectives were:

1. To compare activity levels of gardeners and non-gardeners.
2. To determine if the frequency of gardening affected BMI in gardeners.
3. To compare the difference in BMI of gardeners and non-gardeners.
4. To determine if there was a difference in reported overall health between gardeners and non-gardeners.
5. To determine if there was a difference in reported incidence of allergies between gardeners and non-gardeners.
6. To compare demographic groups of gardeners to determine if any group benefited more within any variables of interest.

Hypothesis

H1. There will be no difference when comparing gardeners and non-gardeners activity levels.

H2. There will be no difference in BMI comparison of gardeners bases on frequency of gardening.

H3. There will be no difference in BMI when comparing gardeners to non-gardeners.

H4. There will be no difference in the reported overall health of gardeners and non-gardeners.

H5. There will be no difference in the reported incidence of allergies in gardeners and non-gardeners.

H6. There will be no difference in comparisons of demographic groups of gardeners concerning any of the variables of interest.

Definition of Terms

Adult: An individual over the age of 20 (CDC, 2007).

Allergies: An abnormal reaction of the body to a previously encountered allergen introduced by inhalation, ingestion, injection, or skin contact, often manifested by itchy eyes, runny nose, wheezing, skin rash, or diarrhea (Allergy, 2015).

Biophilia: A hypothetical human tendency to interact or be closely associated with other forms of life in nature (Biophilia, 2012).

Body-Mass Index (BMI): An estimate of an individual's relative body fat calculated from his or her height and weight (Harvard Medical School, 2009).

High Physical Activity: A physical activity that is greater than six on the MET scale (Park et al., 2014).

Low Physical Activity: A physical activity that is less than three on the MET scale (Park et al., 2014).

Metabolic Equivalent Test (MET): A measure of the exercise intensity of physical activity (Ainsworth et al., 2000).

Moderate Physical Activity: A physical activity that falls anywhere between 3 and 6 on the MET scale (Park et al., 2014).

Normal Weight: A label for a range of weights that are generally considered healthy for a given height. An adult who has a BMI between 18.5 and 24.9 is considered normal weight (CDC, 2014).

Obesity: A label for a range of weights that are greater than what is generally considered healthy for a given height and has been shown to increase the likelihood of certain diseases and other health problems. An adult who has a BMI of 30 or higher is considered obese (CDC, 2014).

Overweight: A label for a range of weights that is greater than what is generally considered healthy for a given height and has been shown to increase the likelihood of certain diseases and other health problems. An adult who has a BMI between 25 and 29.9 is considered overweight (CDC, 2014).

Physical Activity (PA): Specific forms of exercise such as jogging, swimming, calisthenics, bicycling, aerobic, walking/hiking, dancing and weight training (Haskell et al., 2007).

Underweight: Weight that is lower than what is considered as healthy for a given height. An adult that has a BMI less than 18.5 is considered to be underweight (CDC, 2014)

Limitations

1. Any research conducted on humans will have extraneous factors that can influence the outcomes of the study.
2. Non-experimental research based on "real-life" scenarios cannot completely neutralize all extraneous factors.

3. The study was limited to collecting demographic information known to be related to the variables of interest.
4. The study was limited to those participants who voluntarily agreed to participate and were willing to take the time to complete the survey.
5. The study was limited to information collected from one survey collected at one time.

Basic Assumptions

1. There was an assumption the population sample would be representative of the target population.
2. This study was dependent upon the assumption participants would provide honest responses, and would not be informed or biased based on the nature of the study.

CHAPTER II

LITERATURE REVIEW

Demographics of Obesity

In the last quarter century, the epidemic of overweight and obese Americans has increased strikingly. According to the CDC, approximately 34.9% of adults in the United States are obese (CDC, 2014); *The President's Council on Physical Fitness and Sports* estimates nearly 3 of 5 American adults carry unhealthy or excess weight (HHS, 2008). The highest prevalence of obesity in adults is found in African Americans (47.8%), followed by Hispanics (42.5%), Caucasians (32.6%), and Asian Americans (10.8%). In terms of age, obesity in adults is greatest among middle aged adults between the ages 40-59 years old (39.5%), followed by adults over the age of 60 (35.4%) and adults 20-39 (30.3%) (CDC, 2014). Individuals with lower incomes, less education, and those whom live in rural environments are less likely to meet physical activity recommendations when compared to individuals with higher incomes, more education and those whom live in suburban environments (CDC, 2015; Parks et al., 2003). However, the increase in BMIs and obesity is not solely related to individual demographics. It has been found that many demographics such as age, gender, ethnicity, and annual income create a pattern, which may change over time and cause disproportionate rises in BMIs and obesity (Change and Lauderdale, 2005).

Obesity is far more perilous than most adults think because it disables and kills by substantially raising the risk of cardiovascular disease, cholesterol, hypertension, osteoarthritis, stroke, Type II diabetes, specific forms of cancer and other diseases

(CDC, 2007; Weisberg, 2002). Depression has been found to be higher in individuals with chronic diseases and can worsen the health of individuals with reoccurring symptoms of diseases, especially in individuals who suffer from angina, arthritis, asthma, and diabetes (Moussavi et al., 2007). In addition, obesity is associated with increases in all causes of mortality (HHS, 2001; Ogden, 2006; Weisberg, 2002).

Approximately 17% of children age 2 to 19 (or an estimated 12.5 million children), are obese (CDC, 2014). As of 2011-2012, 8.4% of children 2 to 5 were obese compared with 17.7% of children 6 to 11 and 20.5% of 12 to 19 year olds (CDC, 2014). There is also a significant racial difference in levels of obesity in children, with obesity being higher in Hispanic children (22.4%), compared with African Americans (20.2%), Caucasian (14.1%) and Asian American children (8.6%) (CDC, 2014).

The main causes for the increase in the incidence of obesity in children are related to a less active lifestyle, whereas time spent in more sedentary activity, such as playing video games, watching television, and playing on the computer has increased (Murata, 2000; Samuelson, 2000). This in combination with the availability and increase in consumption of sugary drinks and less healthy foods is one of the main reasons childhood obesity is now becoming a growing problem (CDC, 2014).

Cost Factors in Relation to Obesity

The economic consequences of obesity affect both the individual and the nation. In 2008, medical expenses for treating obesity were nearly $147 billion; the medical cost for those people who were obese was $1,429 higher annually compared to those of normal weight (CDC, 2014). Medicare and Medicaid programs pay approximately 50%

of those expenses, and the burden in Texas alone, for the year 2000 meant a cost of $5,340 million dollars to the state (Finkelstein et al., 2004). Throughout the United States, obesity prevalence ranges from a low of 20.5% in Colorado to a high of 37.4% of the population in Louisiana, with a higher prevalence of obesity being found in the Midwest and South and a lower prevalence of obesity being found in the Northeast and West (CDC, 2014). As of 2010, no state had met the nation's *Healthy People 2010* goal to lower obesity prevalence to 15%. Rather, as of 2012, there were 13 states with obesity prevalence of 30% or above (CDC, 2014).

Given the complexity and multiplicity of the forces driving the obesity epidemic, there is no consensus on a specific modality for its abatement. It has been determined that a multitude of factors likely contribute to obesity, one of which is prevalence of physical inactivity (Kopleman, 2000). Therefore, agreement has been reached that weight-management through regular physical activity is one method that can help reduce this epidemic. To promote and maintain health and reduce the incidence of overweight and obese people in society, recommendations have been made suggesting adults engage in physical activity (of low-moderate intensity) for a minimum of 30-45 minutes, three to five days a week; (Haskell, et al., 2007; HHS, 2001; Nelson et al., 2007; Pate et al., 1995). A meta-analysis of literature performed by the Brown University School of Medicine found significantly greater weight loss in exercise alone versus no other treatment control (Wing, 1999). Therefore, advocating regular physical activity and establishing an environment supporting these behaviors are fundamental to addressing this epidemic. Despite the documented benefits of physical activity, more than 50% of

U.S. adults do not get enough physical activity to provide health benefits; and 24% are not active at all in their leisure time (CDC, 2007).

Allergy and Asthma Health Problems

Allergy symptoms, such as stuffy, itchy, or runny nose, and watery, itchy eyes, are common in the United States, affecting approximately one-half of the population (Singh et al., 2010). According to American Academy of Allergy, Asthma, and Immunology (AAAAI) (2015), worldwide, allergies affect between 10-30% of the population. Common allergens include dust mites, ryegrass, ragweed, tree, grass, and weed pollens, and mold spores (Skoner, 2001). Studies have found people with allergy symptoms rate their quality of life lower, have more missed work days, and less productivity at work and school (Bielory et al., 2014). Of the one-half of the U.S. population that suffers from allergies, only 14% of U.S. adults have a physician confirmed diagnosis of allergic rhinitis (Blaiss et al., 2007). One study found that participants indicated March, May, and September as the peak months for seasonal allergy symptoms (Bielory et al., 2014). Nasal congestion was ranked as the most common symptom and was rated as "extremely bothersome." Of the 2765 participants in the study, 29% reported their daily life was impacted "a lot" when allergy symptoms were at their worst (Bielory et al., 2014).

Asthma is a chronic health problem closely associated with allergies that can cause mental and social problems in addition to physical symptoms (Coban and Aydemir, 2014). It has been found that 80% of individuals who have asthma also suffer from allergic rhinitis (Clarke-Jones, 2004). About 25 million or 8% of the U.S.

population suffered from asthma in 2009; this was an increase from 20 million or 7% in 2001. Overall, an estimated 300 million people worldwide suffer from asthma (AAAAI, 2015). The prevalence of asthma has been found to be higher in African American and American Indian persons (CDC, 2012). Between the years 2007-2009, African Americans had a higher rate of emergency visits and hospitalization per 100 persons for asthma when compared to Caucasians. Annual average cost in medical expenses associated with asthma was $3,300 per person from 2002-2007 (AAAAI, 2015). In 2010, asthma was linked to 3,404 deaths in the United States with approximately 250,000 people dying prematurely each year from asthma (AAAAI, 2015).

In a meta-analysis which analyzed 42 studies taking place over a 13 year period, it was found individuals, both adult and children, who consumed more fruits and vegetables had a 36% lower risk of asthma when compared to individuals who consumed fewer fruits and vegetables (Seyedrezazadeh et al, 2014). Furthermore, research has found individuals exposed to farming environments early in their lives are less prone to develop asthma, hay fever, and atopic eczema (Riedler et al., 2001).

Biophilia

There is a special connection between people and plants, as well as people and nature. This innate closeness to plants is thought to have developed from humans' evolution as a part of nature (Simons and Straus, 1998). In Egypt, physicians used natural environments as a means to improve patient health (Simons and Straus, 1998). Written evidence indicates Egyptians during the 3rd century BC brought plants indoors.

Evidence plants were used more than 2000 years ago as decorations for homes was also found in the ruins of Pompeii (Manaker, 1996).

In more recent history, support for the preservation of natural resources and access to parks has been upheld, with the belief that exposure to nature fosters psychological well-being, reduces stress related to modern living, and promotes physical well-being (Ulrich, 1993).

Biophilia is a hypothetical human tendency to interact or be closely associated with other forms of life in nature (Biophilia, 2012). Ulrich (1993) explained biophilia as a hereditary emotional affiliation of human beings to other living organisms, developed through the process of evolution in which individuals who readily learned and remembered various adaptive behaviors were more likely to be rewarded. Due to people evolving in nature, it is hypothesized that people have biophilic responses to certain natural elements; these responses can be both positive and negative (Ulrich, 1993).

It has been proposed when people encounter unthreatening natural landscapes, they respond positively in at least three ways: the liking/approach response, the restoration or stress recovery response, and the enhanced high-order cognitive functioning response. The liking/approach response occurs when humans are naturally drawn to environments due to evolving in certain areas. In the restoration or stress recovery response, humans recover from physiological arousal and negative emotions when immersed in nature. The enhanced high-order cognitive functioning response occurs when a person in a natural setting is better able to perform higher-order cognitive functions such as creative problem solving (Ulrich, 1993). It was hypothesized that

humans respond in these ways due to a primal instinct in which they associate these natural settings with food, water, and security (Ulrich, 1993).

Because much of human evolution took place in savanna like-settings, modern day humans now show a genetic predisposition to be drawn to natural settings which are more open, with scattered trees and relatively uniform heights of grass/groundcover (Ulrich, 1993). By contrast, natural elements found in research to be associated with low preference among viewers include elements hindering free movement and impairing vision, such as dense forests or rough ground terrain (Ulrich, 1993).

Effects of Passive and Active Interaction with Plants

People can interact with plants either passively or actively (Zampini, 1994). Active interaction occurs when an individual is directly involved with the growing of plants (Lewis, 1992). Alternatively, passive interaction occurs when an individual is in the presence of plants, but not actively engaging with them. Passive interaction can occur in two different ways: being in nature and observing nature (Kiyota, 2009). Being in nature includes such things as walking through a tree-filled park or sitting in a garden, while observing nature can include viewing a small potted plant sitting on a desk at work or viewing nature from a window (Kiyota, 2009; Zampini, 1994). The mere presence of plants was found to improve life satisfaction environmentally, economically, socially, culturally, and physically (Waliczek et al., 1996; Zampini, 1994).

Kaplan and Kaplan (1989) proposed reconnecting with nature helps a person to reach four central aspects needed for restoration, reducing mental fatigue: (1) “Being away” involves seeking a method to be away from the current situation causing mental

fatigue; (2) “Extent,” involves the extent to which a place is rich and coherent enough to constitute a whole other world which can be attained physically or perceptually; (3) “Fascination” is something a person finds interesting and meaningful, but does not require direct attention; (4) “Compatibility” is an environment supportive of behavior and helps to reduce mental fatigue (Kaplan and Kaplan, 1989).

Effects of Active Interaction with Plants

Research investigating the demographics of gardeners in the U.S. found most gardeners are women (54%), college graduates (43%), 45 years of age or older (68%), live in the South (29%), and have and annual household income of $50,000 and over (38%) (Butterfield, 2009). However, the age of the average gardener may be decreasing as millennials (18-34 years of age) become more active in gardening; there was a 63% increase in the number of millennials gardening between the years 2008-2013 (National Gardening Association, 2014).

Gardening has long been one of the most common spare-time activities among senior citizens (Hill and Relf, 1982; Sarola, 1994). A survey of one Illinois nursing home found 90% of the residents reported enjoying gardening in the past and is an age-friendly option for improving the quality of life for older adults (Armstrong, 2000; Austin et al., 2006; Milligan el al., 2004; Rothert and Daubert, 1981). Research analyzing leisure activities such as reading, gardening, hunting, and dancing found while people decrease the amount of time performing leisure activities as they age, gardening is a leisure activity people continue to perform more often later in life when compared to other activities they engaged in earlier in life (Agahi et al., 2006). Furthermore, research

surveying older veterans with partial foot and leg amputations found 31% listed gardening as a type of physical activity they performed for exercise (Littman et al., 2014).

Therapies such as gardening in nursing homes have benefited participants by increasing life satisfaction and raising self-esteem (Willcox and Mattson, 1979). One study conducted in a nursing facility examined the value of people-plant interactions by allowing a group of seniors to care for plants. Those who cared for plants were found to be more alert, and interacted more with fellow residents as well as required less staff care, compared to those individuals who had staff care for their plants (Langer and Rodin, 1976). Another study surrounding seniors caring for plants in nursing facilities found individuals who cared for plants had a significant improvement in restoration (the psychological benefits of nature) as well as a significant reduction of depression levels (Kiyota, 2009).

Horticulture has been found to provide benefits in populations beside seniors and is sometimes used in rehabilitation within the corrections industry (Rice and Remy, 1994). One study measured the benefits of active interactions with plants and involved placing juvenile offenders in a vocational horticulture curriculum as a form of community service. The study found horticulture programs possess the potential to reduce recidivism among juvenile offenders, as seen in the Green Brigade program in San Antonio, Texas (Cammack et al., 2002).

Research also found horticulture programs can reduce aggressiveness of institutionalized adolescents (Cotton, 1975). Juvenile offenders were administered a

pretest and a posttest which measured social bonds and career aspirations. After a 17-week horticulture program, results showed the offenders viewed school, teachers, themselves and the overall environment in a more positive way after participating in the horticulture curriculum (McGuinn and Relf, 2001). This research indicated a vocational horticulture curriculum may be a tool to improve social bonding of juvenile offenders, and the tested curriculum appeared to be effective at evoking certain changes in attitudes about personal success and individual perceptions of personal job preparedness (McGuinn and Relf, 2001).

Gardening has been used to combat depression in individuals with disabilities. One study which surveyed disabled gardeners and non-gardeners found disabled individuals who were active in gardening had scores indicating lower levels of depression when compared to disabled individuals who did not garden (Wilson and Christensen, 2011).

Effects of Passive Interaction with Plants

It has been found that observing nature can be a restorative activity for senior citizens. Observing nature enhances concentration and feelings of mental energy, peacefulness, and refreshment by moderating mental fatigue (Jansen and Von Sadovszky, 2004). Research found seniors living in care facilities who frequent garden settings displayed less disruptive behavior when compared to other seniors (Mather et al., 1997). One study conducted on restoration found seniors perceive nature scenes to be preferable and familiar. Familiarity is an especially important factor for seniors when attempting to gain a sense of restoration (Berto, 2007).

Research was conducted on hospital patients who had received appendectomies. Plants were placed in half the patients' rooms while the other patients' rooms were left without plants. Those patients who were exposed to plants requested less weak to moderate analgesics when compared to those patients who were not exposed to plants (Park and Mattson, 2008). Also, patients with plants in their rooms reported less subjective pain as well as less fatigue by the end of the third day. Patients with plants in the rooms also viewed their rooms as being more pleasant when compared to patients who did not have plants in their rooms (Park and Mattson, 2008). Further, research conducted on patients during flexible bronchoscopy procedures found patients who were able to view murals of nature while listening to tapes of nature sounds reported less pain and anxiety during the procedure (Diette et al., 2003).

In a study conducted by Doxey el al. (2009), the effects of live plants within college classrooms on university students were tested by placing plants in several different classrooms, some of which contained windows and some of which did not. It was found when plants were placed in a classroom, the students tended to view the instructor as more pleasant and the course as more enjoyable. Plants tended to have the biggest impact in the room without windows (Doxey et al., 2009).

Research has examined the influence of passive interaction with non-plant materials, such as colored photographs of natural scenes, to determine if a reduction of stress would occur. One study found patients in a dental office felt less stress when a mural depicting a natural scene was hung on a wall of the waiting room, in comparison to when the walls were blank (Heerwagen and Orians, 1986). Similarly, Ulrich (1981)

found slides of nature produced positive feelings and allowed the participants to be more wakefully relaxed.

Gardening in Correlation to Overall Health

Gardening is an activity which is found to influence whole body bone mineral density since it incorporates weight-bearing motions and uses the body in its entirety (Turner et al., 2002). Jogging, swimming and calisthenics were found to be weak predictors for high bone density, whereas bicycling, aerobics, walking, and dancing were moderate predictors, and yard work and weight training were strong predictors (Turner et al., 2002). A recent study determined ten ordinary garden tasks, which included digging, raking, weeding, mulching, hoeing, sowing seed, harvesting, watering, mixing growing medium, and planting transplants were moderate to high intensity physical activities (Park et al., 2014). Of the ten gardening activities tested in the study, all were found to be at least a moderate physical activity while digging was found to be the most physically challenging and listed as a high intensity physical activity (Parks et al., 2014).

Much of the research conducted on gardeners focuses on the benefits to the general health and well-being gardening has to individuals instead of specific illnesses (Davies et al., 2014). Research has found there is a strong association with high rates of obesity in urban areas that lack healthy food choices as well as green spaces. It is generally accepted community gardening and growing food for personal use may increase physical activity and benefit individual diets (Burges-Watson and Moore, 2011; Lake and Townshend, 2006). Other research found individuals who live proximate to green spaces are three times more likely to engage in physical activity and 40% less

likely to be overweight (Ellaway et al., 2005). Furthermore, research comparing physical activity of gardeners to the general population found 68% of gardeners met physical activity recommendations compared to 25% of the general population (Hawkins et al., 2013).

Studies have found that gardening can impact health through diet change. A meta-analysis which analyzed gardening and vegetable consumption in children found overall knowledge of nutrition increases when children were exposed to a nutrition education program; however, when children were exposed to gardening programs, their vegetable and fruit consumption increased (Langellotto and Gupta, 2012). Another study researching community gardening and vegetable consumption found families participating in the study all increased their vegetable and fruit consumption, with adults increasing their consumption four-fold and children increasing their vegetable and fruit consumption three-fold (Carney et al., 2011).

Other research comparing fruit and vegetable consumption in gardeners and non-gardeners found while gardeners were more likely to consume vegetables when compared to non-gardeners, gardening made no difference in frequency of fruit consumption. Additionally, length of time an individual had been gardening seemed to have no relationship to the number of vegetables and fruits consumed; this suggests that gardening intervention programs introduced at any stage of life could be an effective method of boosting vegetable consumption (Sommerfield et al., 2010).

A study analyzing the benefits of participating in a Master Gardener program found individuals who participated in the program reported being more physically

active, had a higher self-esteem, consumed more fruits and vegetables, and maintained a healthier diet compared to before they joined the program (Boyer et al., 2002).

Finally, research comparing BMIs of community gardeners to neighbors, siblings, and spouses who did not participate in community gardening found both men and women community gardeners had significantly lower BMIs when compared to their neighbors or siblings, suggesting the health benefits of gardening may go beyond enhancing the gardeners' intake of fruits and vegetable (Zick el al., 2013).

CHAPTER III

MATERIALS AND METHODS

The main purpose of this research was to investigate the influence of gardening activities on activity levels, body mass index (BMI), allergies, and reported overall health in gardeners and non-gardeners.

The main objectives were:

1. To compare activity levels of gardeners and non-gardeners.
2. To determine if the frequency of gardening affected BMI in gardeners.
3. To compare the difference in BMI of gardeners and non-gardeners.
4. To determine if there was a difference in reported overall health between gardeners and non-gardeners.
5. To determine if there was a difference in reported incidence of allergies between gardeners and non-gardeners.
6. To compare demographic groups of gardeners to determine if any group benefited more within any variables of interest.

Instrumentation

The survey used for this study consisted of five sections, which were modified from previous instruments, and all tested for validity by being shown to a panel of experts. Participants began by differentiating themselves as gardeners or non-gardeners by responding "yes" or "no" to the survey question, "Do you garden?" This question was used in a previous study (Waliczek et al., 2005).

Gardening Time and Activities Survey Section and Scoring

A gardening activity survey was answered only by participants who answered "yes" to the question, "Do you garden?" The gardening activity section consisted of eight questions pertaining to seasonality, duration and frequency of gardening tasks performed during winter, spring, summer, and fall as well as the type of gardening and lawn maintenance tasked performed while gardening at any time. For the frequency and duration questions relating to the different seasons, participants responded by checking from a list of responses ranging from "Most days" to "Never" for frequency and "<30 minutes" to "More than 1 Hour" for duration. For the questions concerning gardening and lawn maintenance, participants responded by checking all answers that applied from a given list. Response options included, "Hand weeding," "Mulching," "Raking," and "Fertilizing the lawn with a hand spreader" among others. The frequency and duration questions were a modified version of a frequency and duration survey used in a previous study which had a reliability of 0.83 in the previous study (Dishman and Steinhardt, 1988).

Data were then transferred to Microsoft Excel™ (Microsoft™ Redmond WA, 2003) where a total gardening time score was summed for each participant with 0 indicating no gardening at any time during any of the four seasons and 36 indicating the highest amount of time spent gardening during the four seasons, with a median score of 18. Participants were then grouped into three categories "Low" (0-12), "Medium" (12-24), and "High" (25-36), based on their total gardening time score.

A total physical gardening activity score was also calculated for each participant. Participants received one point for indicating interaction in each individual activity resulting in a raw score on the test instrument ranging from 0-20. For the purpose of analysis and discussion, these raw scores were converted to a 100-point scale.

Physical Activities Survey Section and Scoring

The next section of the survey consisted of twelve questions pertaining to physical exercise other than gardening. These questions were answered by all participants. The first two questions asked participants to check any physical activities from a given list in which they participated. Answers included, "Jogging," "Swimming," "Yoga," and "Dancing" among others, as well as an open ended space to write activities not included in the list.

A subsequent set of questions pertained to participants' exercise schedule and included questions such as, "My exercise location changes from day-to-day," and "I work out by myself." Participants answered based on a five point Likert type scale ranging from "Never" to "Always." The exercise questions were a modified version of an exercise habit survey used in a previous study and was found to have a reliability of 0.85 in the previous study (Likert, 1967; Tappe and Glanz, 2013).

Data were then transferred to Microsoft Excel™ (Microsoft™ Redmond WA, 2003) where a total activity/exercise score was calculated for each participant. Participants received one point for indicating interaction in each individual activity resulting in a raw score on the test instrument ranging from 0-12. For the purpose of analysis and discussion, these raw scores were converted to a 100-point scale.

Chronic Illness Survey Section and Scoring

The third section of the survey consisted of one question and 43 answer options on a list and asked participants to check any of their reoccurring medical conditions from the list. Examples of answers included, "Dizziness," "Chest pain," "Trouble sleeping," and "High cholesterol," as well as a blank space to write in medical conditions not listed. This list was a modified version of an illness list used in a previous study concerning health and perceptions of nature and was found to have a reliability of 0.87 in the previous study (Hammond et al., 2009).

Data were then transferred to Microsoft Excel™ (Microsoft™ Redmond WA, 2003) where a total health score was calculated for each participant. Participants received one point for indicating reoccurring symptoms for each individual illness resulting in a raw score on the test instrument ranging from 0-43. For the purpose of analysis and discussion, these raw scores were converted to a 100-point scale.

Allergy Survey Section and Scoring

Participants were asked to respond to three questions pertaining to having been diagnosed with allergies, allergy medications, and allergy symptoms in the past 12 months. These questions were a modified version of an allergy survey used in a previous study where it was found to have a reliability of 0.84 (Annesi-Maesano et al., 2002). Participants were asked to answer either "Yes" or "No" to questions such as "Have you had allergy symptoms in the past 12 months?"

Data were then transferred to Microsoft Excel™ (Microsoft™ Redmond WA, 2003) where a total allergy score was calculated for each participant. Participants

received one point for answering "Yes" to each individual question resulting in a raw score on the test instrument ranging from 0-3;. For the purpose of analysis and discussion, these raw scores were converted to a 100-point scale.

Demographics Survey Section

The last section of the survey gathered demographic information and included eight questions regarding the participants' gender, age, weight and height (BMI), ethnicity, annual household income, education level, state of residence, and description of residence (rural, suburban, urban, or inner city). Individual BMIs were grouped into four separate BMI categories: underweight (< 18.5), normal weight (18.5-24.9), overweight (25.0-29.9), and obese (30.0 or greater). The demographics section was a modified version from a previously used study where it had a reported reliability of 0.76 (Dravigne et al., 2008).

Sample Population

The sample population was drawn from two sources. An online survey was created using Survey Monkey (Survey Monkey Inc., 2015) and posted for four months on social media websites and spread through word of mouth. An identical paper-pencil formatted survey was distributed to church, garden, and social and community service groups within Texas and parts of the Midwest (Appendix A). These paper-pencil survey groups were selected for participation based on their ease of accessibility and interest level in participating in the study. Participants were offered a free packet of wildflower seeds as an incentive to take part in the survey. The target population of the study were gardeners and non-gardeners eight years of age and older.

Data Analysis

Data were entered and analyzed using PASW 20.0 (Chicago, IL). Descriptive statistics, frequencies, analysis of variance, and multivariate analysis of variance tests were used to determine if there were differences in ways participants answered questions on the gardening, physical activity/exercise, medical history, and allergy survey, as well as to make demographic comparisons amongst respondents.

CHAPTER IV

RESULTS

The main purpose of this research was to investigate the influence of gardening activities on activity levels, body mass index (BMI), allergies, and reported overall health in gardeners and non-gardeners.

The main objectives were:

1. To compare activity levels of gardeners and non-gardeners.
2. To determine if the frequency of gardening affected BMI in gardeners.
3. To compare the difference in BMI of gardeners and non-gardeners.
4. To determine if there was a difference in reported overall health between gardeners and non-gardeners.
5. To determine if there was a difference in reported incidence of allergies between gardeners and non-gardeners.
6. To compare demographic groups of gardeners to determine if any group benefited more within any variables of interest.

A total of 1,015 surveys were collected over a four month period. Initially, analysis of variance (ANOVA) tests found there were significant differences in age, ethnicity, and annual household income in the sample comparisons of gardeners and non-gardeners. In order to balance the sample demographically, 174 participants were removed from the study leaving 841 participants (Table 1), 442 of which were gardeners and 399 non-gardeners. Ethnicity remained statistically significantly different after the removal of participants because a majority, 679, of the 841 participants were Caucasian.

The majority of overall participants were female (497, 59.2%), between the ages of 18-29 (305, 36.4%), of normal weight (441, 53.4%), had an annual household income greater than 95K (169, 20.7%), and had a college degree (292, 35.0%).

Table 1. Descriptive statistics for demographics of gardener and non-gardener participants, number of observations taken in each demographic group and percent of gardeners and non-gardeners within each demographic group.

Demographics	Gardeners (n)[z]	Gardeners (%)	Non-gardeners (n)[y]	Non-gardeners (%)
Gender				
Female	268	60.6	229	57.7
Male	174	39.4	168	42.3
Age				
18-22	154	34.8	151	37.9
23-29	156	35.3	142	35.7
30-39	69	15.6	66	16.6
40-49	24	5.4	14	3.5
50-59	20	4.5	17	4.3
60-69	12	2.7	4	1.0
70+	6	1.4	4	1.0
Grouped BMI[x] score				
Underweight	21	4.8	13	3.4
Normal weight	222	50.2	219	56.7
Overweight	124	28.1	82	21.2
Obese	73	16.5	72	18.7
Ethnicity				
African American	5	1.1	9	2.3
Asian	10	2.3	23	5.8
Hispanic	21	4.8	34	8.5
Native American	5	1.1	0	0.0
Caucasian	374	84.6	305	76.4
Other	26	5.9	26	6.5

Table 1 Continued

Demographics	Gardeners (n)[z]	Gardeners (%)	Non-gardeners (n)[y]	Non-gardeners (%)
Annual household income				
< 15K	67	15.2	63	16.1
15-29K	66	14.9	60	15.3
30-44K	47	10.6	67	17.1
45-59K	47	10.6	44	11.3
60-74K	47	10.6	27	6.9
75-84K	25	5.7	22	5.6
84-94K	42	9.5	25	6.4
>95K	86	19.5	83	21.2
Education				
Grade school only	3	0.7	3	0.8
GED/high school diploma	43	9.7	35	8.8
College degree	145	32.8	147	36.9
Trade school	6	1.4	6	1.5
Some high school	6	1.4	13	3.3
Some college	161	36.4	129	32.4
Post graduate	73	16.5	64	16.1

[z]N =442
[y]N =399
[x] Individual BMIs were grouped into four separate BMI categories, underweight (< 18.5), normal weight (18.5-24.9), overweight (25.0-29.9), and obese (30.0 or greater).

Findings Related to Objective 1

The first objective of the study was to compare activity levels of gardeners and non-gardeners.

Participants were asked to check all forms of physical activity/exercise, other than gardening, in which they engage at any time of the year from a given list. Activities

included, “Jogging,” “Swimming,” “Yoga,” and “Dancing,” among others, as well as an open area to write any activity/exercise not included in the list. An activity/exercise score was calculated for each participant for individual activities/exercises. Participants received a raw score on the test instrument ranging from 0-12. ANOVA tests indicated a significant difference between total activity/exercise scores of gardeners compared to non-gardeners (P= 0.030) (Table 2).

Descriptive tests indicated gardeners had total physical activity/exercise raw scores ranging from 0-10. Non-gardeners had total physical activity/exercise raw scores ranging from 0-12. For the purpose of analysis and discussion, these raw scores were converted to a 100-point scale. Results indicated non-gardeners participated in more physical activities, other than gardening, when compared to gardeners (Table 2).

Table 2. Analysis of variance comparison and descriptive statistics of total physical activity/exercise score conducted by gardeners and non-gardeners and mean activity/exercise scores for each group.

Group	N	Mean physical activity/exercise score[z]	SD	df	F	*P*
Total	841	27.33	1.94	1.00	4.744	0.030[*]
Gardeners	442	26.25				
Non-gardeners	399	28.58				

[z]Participants received a raw score on the test instrument ranging from 0-12. Participants received one point for indicating interaction in each individual activity/exercise. For the purpose of analysis and discussion, these raw scores were converted to a 100-point scale.
[*]Significant at $P \leq 0.05$

ANOVA test results indicated a statistically significant difference in four individual physical activities/exercises: “Jogging” (P =0.033), “Swimming” (P =0.034),

"Calisthenics" (P =0.036), and "Martial Arts" (P =0.029) (Table 3). Frequency tests showed non-gardeners engaged in each of these activities more than gardeners (Table 3).

Table 3. Analysis of variance comparison of individual physical activity/exercise performed by gardeners and non-gardeners, comparison of frequency statistics for gardeners and non-gardeners for individual physical activity/exercise of jogging, swimming, calisthenics, and martial arts, the total number of observations taken in each category and the percent of individuals in each category.

Physical activities/exercises	Gardeners (n)[z]	Gardeners (%)	Non-gardeners (n)[y]	Non-gardeners (%)	df	F	*P*
Jogging	188	42.6	199	49.9	1.00	4.437	0.033*
Swimming	124	28.1	139	34.8	1.00	4.410	0.034*
Calisthenics	27	6.1	40	10.0	1.00	4.359	0.036*
Martial arts	17	3.8	29	7.3	1.00	4.730	0.029*

[z]N gardeners =442
[y]N non-gardeners =399
*Significant at $P \leq 0.05$

Participants were asked to check all forms of physical gardening activity/exercise in which they engage at any time of the year from a given list. Activities included: "Mowing," "Weeding by hand," "Fertilizing with a hand spreader," and "Mulching," among others, as well as an open area to write gardening activities/exercises not included in the list. A gardening activity/exercise score was calculated for each participant for individual activities/exercises. Participants received a raw score on the test instrument ranging from 0-20. For the purpose of analysis and discussion, these raw scores were converted to a 100-point scale. ANOVA tests indicated a significant difference between the total physical gardening activity/exercise score of gardeners compared to non-gardeners (P= 0.000) (Table 4).

Descriptive tests indicated gardeners had total physical gardening activity/exercise raw scores ranging from 0-20. Non-gardeners had a total physical gardening activity/exercise score of zero (Table 4).

Table 4. Analysis of variance comparison and descriptive statistics of total physical gardening activity/exercise score conducted by gardeners and non-gardeners and mean gardening activity/exercise scores for each group.

Dependent variable	N	Physical gardening activity/exercise score[z]	SD	df	F	*P*
Total	841	24.05	5.61	1.00	2400.640	0.000[*]
Gardeners	422	45.80				
Non-gardeners	399	0.00				

[z]Participants received a raw score on the test instrument ranging from 0-20. Participants received one point for indicating interaction in each individual activity/exercise. For the purpose of analysis and discussion, these raw scores were converted to a 100-point scale.
[*]Significant at $P \leq 0.05$

Participants' total physical activity/exercise scores and total physical gardening activity/exercise scores were combined to determine an overall physical activity/exercise score for gardeners and non-gardeners. An overall physical activity/exercise score was calculated for each participant. Participants received a raw score on the test instrument ranging from 0-32. For the purpose of analysis and discussion, these raw scores were converted to a 100-point scale. ANOVA test results indicated a statistically significant difference for overall physical activity/exercise scores between gardeners and non-gardeners (P= 0.000) (Table 5).

Descriptive tests indicated gardeners had overall physical activity/exercise raw scores ranging from 0-26; non-gardeners had overall physical activity/exercise raw scores ranging from 0-12. For the purpose of analysis and discussion, these raw scores were converted to a 100-point scale. These findings indicate non-gardeners participate in

more types of non-gardening physical activity/exercise when compared to gardeners. However, when gardening activities were taken into consideration, overall, gardeners participated in more physical activity/exercise. This supports past research which found participants reporting being more physical active after taking up gardening activities (Boyer et al., 2002).

Table 5. Analysis of variance comparison and descriptive statistics of overall physical activity/exercise scores of gardeners and non-gardeners and mean activity/exercise scores for gardeners and non-gardeners.

Dependent variable	N	Overall physical activity/ exercise score[z]	SD	df	F	*P*
Total	841	25.31	5.61	1.00	1390.548	0.000[*]
Gardeners	552	38.46				
Non-gardeners	399	10.71				

[z]Participants received a raw score on the test instrument ranging from 0-32. Participants received one point for indicating interaction in each individual activity/exercise. For the purpose of analysis and discussion, these raw scores were converted to a 100-point scale.
[*]Significant at $P \leq 0.05$

Findings Related to Objective 2

The second objective of the study was to determine if the frequency of gardening affected BMI in gardeners.

Participants identifying themselves as gardeners were asked how frequently they gardened during each season. Responses ranged from "Never" to "Most Days." Additionally, gardeners were asked the duration of time they spent gardening according to their frequency of gardening. Responses ranged from "Never" to "More than 1 hour."

Based on participant responses, a raw score ranging from 0-36 was calculated; raw scores were used to group participants into three categories: “Low” (0-12), “Medium” (13-24), and “High” (25-36).

ANOVA test results indicated frequency of gardening did not have a statistically significant difference on gardeners BMIs (*P* =0.825) (Table 6). Descriptive statistics found gardeners overall BMI mean score to be 25.21 (Table 6), or on average, just slightly overweight (normal weight BMI =18.5-24.9). Gardener BMIs were slightly lower when compared to the mean BMI of the study population (Table 7).

The sample population of gardeners was matched to the sample population of non-gardeners demographically but overall the sample group was young (18-30) and in the age range with the lowest incidence of overweight and obesity issues (CDC, 2014). These findings indicate individuals of all sizes are drawn to the activity of gardening and suggest a link to past research which found gardening activities to be moderate to high intensity physical activities (Park et al., 2014). These finding also suggest a link to research which found gardeners were more likely to meet physical activity recommendations more often when compared to the general population (Hawkins et al., 2013).

Table 6. Analysis of variance comparison and descriptive statistics of gardeners BMI score in relation to frequency and duration of time spent gardening by gardeners, mean BMI score of gardeners in each gardening frequency category, and overall BMI mean score.

Dependent variable	Gardeners (n)[x]	Mean BMI[z] gardener score	SD	df	F	*P*
Overall underweight	21	17.39	0.90	2.00	0.428	0.658
Low frequency[y]	1	17.20				
Medium frequency	15	17.51	0.82			
High frequency	5	17.39	1.23			
Overall normal weight	222	21.88	1.73	2.00	0.144	0.866
Low frequency	21	21.89	1.55			
Medium frequency	152	21.84	1.80			
High frequency	49	21.99	1.63			
Overall overweight	124	26.89	1.47	2.00	0.189	0.828
Low frequency	6	27.08	2.12			
Medium frequency	98	26.85	1.46			
High frequency	20	27.04	1.47			
Overall obese	73	34.76	4.64	2.00	0.28	0.973
Low frequency	6	34.33	3.12			
Medium frequency	46	34.80	5.12			
High frequency	21	34.76	4.64			
Overall frequency/duration gardener BMI	440	25.21	5.49	2.00	0.193	0.825
Overall low frequency	34	24.86	1.55			
Overall medium frequency	311	25.13	5.39			
Overall high frequency	95	25.63	5.92			

[z]Individual BMIs were grouped into four separate BMI categories, underweight (< 18.5), normal weight (18.5-24.9), overweight (25.0-29.9), and obese (30.0 or greater).
[y]Based on participant responses to frequency and duration of time spent gardening questions a raw score ranging from 0-36 was calculated; raw scores were used to group participants into three categories "Low" (0-12), "Medium" (13-24), and "High" (25-36).
[x]N =440

Findings Related to Objective 3

The third objective of the study was to compare the difference in BMI of gardeners and non-gardeners.

ANOVA test results indicated no statistically significant difference between BMI scores of gardeners when compared to non-gardeners (P =0.807) (Table 7). Descriptive tests found the overall mean BMI score for the study to be 25.34 (overweight 25.0-29.9). Descriptive statistics showed that non-gardeners overall mean BMI score was slightly above the overall mean BMI score (Table 7), while gardeners overall mean BMI score was slightly below the overall mean BMI score. Therefore, in general, it appeared non-gardeners were slightly more overweight when compared to gardeners. However, in this study, there was not enough evidence to state support of past research which found gardeners were more prone to have lower BMI scores when compared to those not involved in gardening (Zick et al., 2013). The sample population of gardeners was matched to the sample population of non-gardeners demographically but overall the sample group was young (18-30) and in the age range with the lowest incidence of overweight and obesity issues (CDC, 2014).

Table 7. Analysis of variance comparison and descriptive statistics of gardeners and non-gardeners BMI scores in each BMI category and overall mean BMI score of gardeners and non-gardeners.

BMI categories	(n)[y]	Mean BMI score[z]	SD	df	F	*P*
Overall underweight	34	17.39	0.88	1.00	0.000	0.988
Gardeners	21	17.39	0.90			
Non-gardeners	13	17.40	0.88			
Overall normal weight	441	21.86	1.78	1.00	0.040	0.842
Gardeners	222	21.88	1.73			
Non-gardeners	219	21.84	1.84			
Overall overweight	206	26.99	1.46	1.00	1.494	0.223
Gardeners	124	26.89	1.47			
Non-gardeners	82	27.15	1.46			
Overall obese	145	35.45	4.67	1.00	3.255	0.073

Table 7 Continued

BMI categories	(n)[y]	Mean BMI score[z]	SD	df	F	*P*
Gardeners	73	34.76	4.64			
Non-gardeners	72	36.15	4.64			
Gardeners overall BMI	440	25.21	5.49			
Non-gardeners overall BMI	386	25.49	6.16			

[z]Individual BMIs were grouped into four separate BMI categories, underweight (< 18.5), normal weight (18.5-24.9), overweight (25.0-29.9), and obese (30.0 or greater).
[y]N =826

Findings Related to Objective 4

The fourth objective of the study was to determine if there was a difference in reported overall health between gardeners and non-gardeners.

Participants were asked to check all chronic illnesses they had from a given list. Illnesses included, "Headache," "Anxiety," "High Cholesterol," and "Arthritis," among others, as well as an open area to write any chronic illnesses not included in the list. A health score was calculated for each participant for individual chronic illnesses. Participants received a raw score on the test instrument ranging from 0-43. For the purpose of analysis and discussion, these raw scores were converted to a 100-point scale. ANOVA tests indicated there were no statistically significant differences between overall health scores of gardeners compared to non-gardeners (P =0.492) (Table 8).

Descriptive tests indicated gardeners had overall raw health scores ranging from 0-39. Non-gardeners had overall raw health scores ranging from 0-22. Descriptive tests found the overall mean health score for the study to be 11.58. Non-gardeners' overall mean health score was slightly below the overall mean health score (Table 8). Gardeners' overall mean health score was slightly above the overall mean health score.

Table 8. Analysis of variance comparison and descriptive statistics of overall health score conducted by gardeners and non-gardeners and mean scores for each group.

Dependent variable	N	Overall health score[z]	SD	df	F	*P*
Total	841	11.58	4.81	1.00	0.472	0.492
Gardeners	422	11.67				
Non-gardeners	399	11.30				

[z]Participants received a raw score on the test instrument ranging from 0-43. Participants received one point for indicating reoccurring symptoms for each individual illness. For the purpose of analysis and discussion, these raw scores were converted to a 100-point scale.

ANOVA test results found statistically significant differences for five chronic illnesses: "Ear Infection/Ear Ache" (*P*=0.013), "High Cholesterol" (*P*=0.048), "Kidney Stone" (*P*=0.032), "Gallstones" (*P*=0.017), and "Arthritis" (*P*=0.016) (Table 9). Frequency statistics indicated gardeners were more likely to list having reoccurring symptoms for all statistically significant chronic illness when compared to non-gardeners (Table 9).

Much of the research conducted on gardeners focuses on the benefits to the general health and well-being gardening has to individuals instead of specific illnesses (Davies et al., 2014). Gardening has been found to increase physical activity and fruit and vegetable consumption, both of which are recommended to reduce the risks of certain chronic illnesses. However considerations such as frequency of alcohol consumption and smoking also contribute to chronic illness (Boyer et al., 2002, Carney et al., 2011, CDC, 2015). Chronic illness can lead to depression which can worsen a person's overall health (Moussavi et al., 2007). Research has found gardening can help to reduce depression in individuals with disabilities and increase overall life satisfaction

(Waliczek et al., 2005; Wilson and Christensen 2011). Biophilia is a hypothetical human tendency to interact or be closely associated with other forms of life in nature (Biophilia, 2012). Due to people evolving in nature, it is hypothesized that people have biophilic responses to certain natural elements; these responses can be both positive and negative (Ulrich, 1993). The fact that gardeners had higher incidences of certain chronic illness may suggest a link to past research which found plants and scenes of nature can be used as a form of distraction therapy, which can significantly reduce pain, the amount of pain medication needed, anxiety, fatigue, and allow individuals to feel more wakefully relaxed (Diette et al., 2003; Park and Mattson, 2008; Ulrich, 1981). Gardeners with chronic illness may be drawn to gardening because it is a form of physical activity in which they can comfortably participate in a convenient non-judgmental atmosphere.

Table 9. Analysis of variance comparison of individual chronic illnesses between gardeners and non-gardeners, comparison of frequency statistics for gardeners and non-gardeners who responded as having chronic problems with ear infections/ear aches, high cholesterol, kidney stones, gallstones, and arthritis, the total number of observations taken in each category and the percent of individual in each category.

Dependent variable	Gardeners (n)[z]	Gardeners (%)	Non-gardeners (n)[y]	Non-gardeners (%)	SD	df	F	*P*
Ear infection/ear ache	39	8.8	18	4.5	0.25	1.00	6.203	0.013*
High cholesterol	18	4.1	7	1.8	0.16	1.00	3.915	0.048*
Kidney stones	10	2.3	2	0.5	0.11	1.00	4.639	0.032*
Gallstones	9	2.0	1	0.3	0.10	1.00	5.716	0.017*
Arthritis	26	5.9	10	2.5	0.20	1.00	5.860	0.016*

[z]N =442
[y]N =399
*Statistically significant at ($P \leq 0.05$).

Findings Related to Objective 5

The fifth objective of the study was to determine if there was a difference in reported incidence of allergies between gardeners and non-gardeners.

ANOVA test results indicated there were no statistically significant differences in incidence of allergies between gardeners and non-gardeners (P =0.351) (Table 10). For the purpose of analysis and discussion, raw scores were converted to a 100-point scale. Descriptive tests indicated the overall mean allergy score to be 40.33. Gardeners had a total allergy score slightly higher when compared to the mean allergy score of the study (Table 10). Non gardeners had a slightly lower total allergy score from the mean allergy score of the study (Table 10).

Despite spending more time outdoors during seasons when pollen is abundant, gardeners were not found to have any differences in allergies. Past research has found several causes of seasonal allergies to be tree, grass, and weed pollens and outdoor mold spores (Skoner, 2001). Furthermore, research found individuals exposed to farming environments in their early childhood have less frequent occurrences of asthma, hay fever, and atopic eczema (Riedler et al., 2001).

Table 10. Analysis of variance comparison and descriptive statistic scores for individual allergy questions, "Have you been diagnosed with allergies," "Do you take allergy medication," and "Have you had allergy symptoms in the past 12 months," total allergy scores for gardeners and non-gardeners, and mean scores for each question.

Dependent variable	N[y]	Mean gardener score[z]	Mean non-gardener score	SD	df	F	*P*
Have you been diagnosed with allergies?	836	11.33	10.33	0.47	1.00	0.871	0.351
Do you take allergy medicine?	832	9.66	9.33	.045	1.00	0.094	0.760

Table 10 Continued

Dependent variable	N[y]	Mean gardener score[z]	Mean non-gardener score	SD	df	F	*P*
Have you had allergy symptoms in the past 12 months?	832	20.41	20.36	0.48	1.00	0.001	0.970
Total allergy score[x]	841	41.00	39.66	1.17	1.00	0.238	0.626

[z]Participants received one point for answering "Yes" to each individual question. For the purpose of analysis and discussion, these raw scores were converted to a 100-point scale.
[y]N Gardeners =441; N Non-Gardeners =399
[x]Total mean allergy score =40.33

Findings Related to Objective 6

The sixth objective of the study was to compare demographic groups of gardeners to determine if any group benefited more within any variables of interest. A multivariate analysis of variance (MANOVA) test was used to analyze differences in overall physical activity/exercise scores, total health scores, total allergy scores, and BMIs bases on demographics of gardeners (Table 11). Statistically significant differences were found in annual household income (P =0.005) (Table 11).

Table 11. Multivariate analysis of variance indicating the mean scores of total physical score, total health score, total allergy score, and BMI, scores based on demographics of gardeners.

Demographics	Overall physical activity/exercise mean score[z]	Total health mean score[y]	Total allergy mean score[x]	BMI mean score[w]	df	F	*P*	Eta[2]
Gender	38.46	11.83	41.00	25.21	1.00	2.307	0.060	0.046
Female	38.20	13.59	45.90	25.26				
Male	40.18	9.57	37.96	26.48				
Age	38.46	11.83	41.33	25.22	6.00	1.510	0.056	0.045
18-22	38.80	11.43	42.00	23.07				
23-29	39.45	11.17	39.03	25.81				
30-39	41.33	11.85	43.77	27.49				
40-49	40.48	10.03	46.00	26.75				
50-59	37.38	13.48	46.17	27.59				
60-69	30.73	19.77	53.70	28.50				
70+	28.91	8.72	33.33	30.70				
Ethnicity	38.50	11.83	41.33	25.22	5.00	1.066	0.381	0.027
African American	45.83	13.95	11.10	26.70				
Asian	46.88	11.63	48.13	24.32				
Hispanic	34.08	8.64	42.87	25.40				
Native American	53.13	11.63	46.67	26.00				
Caucasian	39.35	12.14	41.20	25.90				
Other	34.67	11.46	50.80	26.09				
Annual household income	38.68	11.95	41.33	25.24	7.00	1.845	0.005*	0.063
<15K	36.58	13.46	42.67	24.93				
15-29K	35.07	11.91	33.80	25.55				
30-44K	40.57	13.05	43.67	28.21				
45-59K	38.42	10.92	44.93	25.67				
60-74K	37.31	9.71	33.67	26.15				
75-84K	40.76	9.46	50.87	26.45				
85-94K	44.61	10.51	40.03	23.92				
>95K	41.3	13.36	48.57	25.09				
Education	38.46	11.67	41.33	25.24	6.00	0.733	0.820	0.022
Grade school only	32.29	6.98	0.00	28.33				

Table 11 Continued

Demographics	Overall physical activity/exercise mean score[z]	Total health mean score[y]	Total allergy mean score[x]	BMI mean score[w]	df	F	*P*	Eta^2
GED/high school degree	38.98	10.30	39.50	24.26				
College degree	38.84	10.52	40.40	26.03				
Trade school	51.25	14.88	60.00	26.14				
Some high school	40.94	20.00	30.00	24.08				
Some college	39.14	13.10	42.47	25.82				
Post graduate	38.56	11.76	48.37	26.37				

[z]Participants received a raw score on the test instrument ranging from 0-32; participants received one point for indicating interaction in each individual activity/exercise. For the purpose of analysis and discussion, these raw scores were converted to a 100-point scale.
[y]Participants received a raw score on the test instrument ranging from 0-43; participants received one point for indicating reoccurring symptoms for each individual illness. For the purpose of analysis and discussion, these raw scores were converted to a 100-point scale.
[x]Participants received one point for answering "Yes" to each individual question. For the purpose of analysis and discussion, these raw scores were converted to a 100-point scale.
[w]Individual BMIs were grouped into four separate BMI categories, underweight (< 18.5), normal weight (18.5-24.9), overweight (25.0-29.9), and obese (30.0 or greater).
*Statistically significant at ($P \leq 0.05$).

Post-hoc tests were used to analyze where the differences existed in the MANOVA. For annual household income statistically significant differences were found in overall physical activity/exercise scores between the "85-94K" category and the "<15K," "15-29K," "45-59K," and "60-74K" categories. This indicated participants that had annual household incomes between 85-94K had higher overall physical activity/exercise mean scores compared to participants in the "<15K," "15-29K," "45-59K," and "60-74K" categories (Table 12). These findings suggest a link to past research which found individuals with higher annual incomes are more likely to meet physical activity recommendations than individuals with lower incomes (Parks et al., 2003). Amongst gardeners of different genders, age, education level, and ethnicity, there were no differences in activity levels, health problems and incidence of allergies. Gardening

appears to be an activity that can benefit all similarly. This is supported by past research which found gardening to cross demographic characteristics and benefit groups from all age, gender, education level, and ethnicity (Alaimo et al., 2008; Boyer et al., 2002; Peeters et al., 2014; Sommerfeld et al., 2010).

Table 12. Descriptive statistics of the overall physical activity/exercise category grouped by annual household income categories for post-hoc analysis in the study of the influence of gardening activities on reports of health problems, allergies, and body mass index.

Annual household income	(n)[z]	Min. activity score	Max. activity score	Overall physical activity/exercise mean score[y]	SD
<15K	67	12.50	71.87	36.58	4.59
15-29K	66	12.50	67.75	35.07	4.26
45-59K	47	9.35	81.25	38.42	4.70
60-74K	47	15.62	68.75	37.31	3.78
85-94K	42	0.00	78.12	44.61	5.03

[z]N =427

[y]Participants received a raw score on the test instrument ranging from 0-32; participants received one point for indicating interaction in each individual activity/exercise. For the purpose of analysis and discussion, these raw scores were converted to a 100-point scale.

Statistically significant difference were also found for annual household income in BMIs between the "30-44K" category and the "<15K," "45-59K," "85-94K," and ">95K" as well as the "85-95K" category and the "15-29K," "30-44K," "60-74K," "75-84K" categories. This indicated that participants having annual household incomes between 30-44K had statistically significant higher BMIs when compared to participants in the "<15K," "45-59K," "85-94K," and ">95K" categories (Table 13). Furthermore, findings indicated participants who had annual household incomes between 85-95K had statistically significant lower BMI scores when compared to participants in the "15-

29K," "30-44K," "60-74K," "75-84K" categories (Table 14). Amongst gardeners of different genders, age, education level, and ethnicity, there were no differences in activity levels, health problems and incidence of allergies. Gardening appears to be an activity that can benefit all similarly. This is supported by past research which found gardening to cross demographic characteristics and benefit groups from all age, gender, education level, and ethnicity (Alaimo et al., 2008; Boyer et al., 2002; Peeters et al., 2014; Sommerfeld et al., 2010).

Table 13. Descriptive statistics of the BMI grouped by annual household income categories for post-hoc analysis between the "30-44K" category and the "<15K," "45-59K," "85-94K," and ">95K" categories and "85-95K" category and the "15-29K," "30-44K," "60-74K," "75-84K" in the study of the influence of gardening activities on reports of health problems, allergies, and body mass index.

Annual household income	(n)[z]	Min. BMI score	Max. BMI score	BMI mean score[y]	SD
<15K	67	17.00	41.60	24.93	5.29
15-29K	65	16.90	25.64	25.55	5.69
30-44K	47	17.10	54.60	28.21	7.80
45-59K	47	18.50	43.90	25.67	5.61
60-74K	47	17.20	42.50	26.15	5.29
75-84K	25	16.10	38.30	26.45	4.67
85-94K	42	18.90	38.90	23.92	4.13
>95K	85	15.00	37.80	25.09	4.65

[z]N =427

[y]Individual BMIs were grouped into four separate BMI categories, underweight (< 18.5), normal weight (18.5-24.9), overweight (25.0-29.9), and obese (30.0 or greater).

CHAPTER V

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

Purpose of the Study

The main purpose of this research was to investigate the influence of gardening activities on activity levels, body mass index (BMI), allergies, and reported overall health in gardeners and non-gardeners. The main objectives were:

1. To compare activity levels of gardeners and non-gardeners.
2. To determine if the frequency of gardening affected BMI in gardeners.
3. To compare the difference in BMI of gardeners and non-gardeners.
4. To determine if there was a difference in reported overall health between gardeners and non-gardeners.
5. To determine if there was a difference in reported incidence of allergies between gardeners and non-gardeners.
6. To compare demographic groups of gardeners to determine if any group benefited more within any variables of interest.

Objective 1

The first objective of the study was to compare activity levels of gardeners and non-gardeners.

Results from the research showed non-gardeners participate in more non-gardening physical activity/exercise when compared to gardeners. However, when

gardening activities were taken into consideration, overall, gardeners participated in more physical activities/exercises. This supported past research which found participants to report being more physical active after taking up gardening activities (Boyer et al., 2002).

Objective 2

The second objective of the study was to determine if the frequency of gardening affected BMI in gardeners.

Participants identifying themselves as gardeners were asked how frequently they gardened during each season. Additionally, gardeners were asked the duration of time they spent gardening according to their frequency of gardening.

Results indicated frequency of gardening did not have a statistically significant difference on gardeners' BMIs. Gardeners on average were slightly overweight though they still had slightly lower BMIs when compared to the mean BMI of the study. These findings suggest a link to past research which found gardening activities to be moderate to high intensity physical activities (Park et al., 2014). These finding also suggest a link to research which found gardeners were more likely to meet physical activity recommendations more often when compared to the general population (Hawkins et al., 2013).

Objective 3

The third objective of the study was to compare the difference in BMI of gardeners and non-gardeners.

Results from the research showed there were no statistically significant differences between BMI scores of gardeners compared to non-gardeners.

In this study, there was not enough evidence to state support of past research which found gardeners were more prone to have lower BMI scores when compared to those not involved in gardening (Zick et al., 2013). The lack of a difference in BMI scores between gardeners and non-gardeners may be due to the majority of the sample population being younger (18-30). Research has found that overweight and obesity is more prevalent in middle aged people between the ages 40-59 (CDC, 2014) and these findings may vary in an older sample population.

Objective 4

The fourth objective of the study was to determine if there was a difference in reported overall health between gardeners and non-gardeners.

Results indicated there were no statistically significant differences between overall health scores of gardeners compared to non-gardeners. However, results also found statistical significant differences for five specific chronic illnesses: "Ear Infection/Ear Ache," "High Cholesterol," "Kidney Stone," "Gallstones," and "Arthritis." Gardeners were more likely to list having reoccurring symptoms for each of these chronic illnesses when compared to non-gardeners.

Much of the research conducted on gardeners focuses on the benefits to the general health and well-being gardening has to individuals instead of drawing conclusions on specific illnesses (Davies et al., 2014). Gardening has been found to increase physical activity and fruit and vegetable consumption, both of which are

recommended to reduce the risks of certain chronic illnesses. Chronic illness can lead to depression which can worsen a person's overall health (Moussavi et al., 2007). Research has found gardening can help to reduce depression in individuals with disabilities and increase overall life satisfaction (Waliczek et al., 2005; Wilson and Christensen 2011). The fact that gardeners had higher incidences of certain chronic illness may suggest a link to past research which found plants and scenes of nature to be beneficial as a form of distraction therapy, which can significantly reduce pain, the amount of pain medication needed, anxiety, and fatigue in individuals (Diette et al., 2003; Park and Mattson, 2008).

Objective 5

The fifth objective of the study was to determine if there was a difference in reported incidence of allergies between gardeners and non-gardeners.

Results indicated there were no statistically significant differences in incidence of allergies between gardeners and non-gardeners. Despite spending more time outdoors during seasons when pollen is abundant, gardeners were not found to have any differences in allergies. Past research has found several causes of seasonal allergies to be tree, grass, and weed pollens and outdoor mold spores (Skoner, 2001). Furthermore, past research found individuals exposed to farming environments in their early childhood have less frequent occurrences of asthma, hay fever, and atopic eczema (Riedler et al., 2001).

Objective 6

The sixth objective of the study was to compare demographic groups of gardeners to determine if any group benefited more within any variables of interest.

Statistically significant differences were found in annual household income of gardeners and its relationship to overall physical activity/exercise and BMIs. Participants that had annual household incomes between 85-94K had higher overall physical activity/exercise mean scores compared to participants in the "<15K," "15-29K," "45-59K," and "60-74K" categories. These findings suggest a link to past research which found individuals with higher annual incomes are more likely to meet physical activity recommendations when compared to individuals with lower incomes (Parks et al., 2003).

Participants having annual household incomes between 30-44K had statistically significant higher BMIs when compared to participants in the "<15K," "45-59K," "85-94K," and ">95K" categories. Furthermore, findings indicated participants who had annual household incomes between 85-95K had statistically significant lower BMI scores when compared to participants in the "15-29K," "30-44K," "60-74K," "75-84K" categories. Amongst gardeners of different genders, age, education level, and ethnicity, there were no differences in activity levels, health problems and incidence of allergies. Gardening appears to be an activity that can benefit all similarly. This is supported by past research which found gardening to cross demographic characteristics and benefit groups from all age, gender, education level, and ethnicity (Alaimo et al., 2008; Boyer et al., 2002; Peeters et al., 2014; Sommerfeld et al., 2010).

Conclusions

The following conclusions were made from this research:

1. Results from this study indicated non-gardeners were more likely to perform more types of physical activity/exercise other than gardening. However, gardeners reported more physical activity when gardening was considered as a form of exercise.
2. Results from this study indicated the frequency of gardening performed by gardeners did not have an effect on gardeners BMI.
3. Results from this study indicated there were no differences in BMI scores between gardeners and non-gardeners.
4. Results from this study indicated gardeners had more reoccurring symptoms of chronic illnesses than non-gardeners indicating participants may be using gardening as a distraction therapy.
5. Results from this study indicated there were no differences in the incidence of allergies between gardeners and non-gardeners.
6. Results from this study indicated gardeners with higher annual household incomes were more likely to be physically active when compared to gardeners with lower annual household incomes.

Amongst gardeners of different genders, age, education level, and ethnicity, there were no differences in activity levels, health problems and incidence of allergies. Gardening appears to be an activity that can benefit all similarly and has been found in past research to be a medium to high intensity exercise (Park et al., 2014), revealing

gardening keeps people active who might not be able to perform exercises such as jogging, martial arts, and cross fit. This may be due to gardening being more accessible since it can be done in containers and/or plots at home. Furthermore, research from this study indicates gardening helps people with chronic illness to stay physically active. This may be due to the fact that gardening and scenes of nature can be used as a form of distraction therapy, which can significantly reduce the amount of pain, the amount of pain medication needed, anxiety, and fatigue in individuals (Diette et al., 2003; Park and Mattson, 2008). Chronic illness can lead to depression which can worsen a person's overall health (Moussavi et al., 2007). Research has found gardening can help to reduce depression in individuals with disabilities and increase overall life satisfaction (Waliczek et al., 2005; Wilson and Christensen 2011). Finally, gardening activities do not make illnesses or allergies worse suggesting a link to past research stating if gardening is started early in life it can reduce the incidence of asthma, hay fever, and atopic eczema (Riedler, 2001).

Potential Real-World Applications

The following suggestions regard the potential real-world use of information found in this study:

1. Gardening can be used to increase the activity level of individuals.
2. Gardening may be used as a form of distraction therapy and in turn reduces the amount of perceived pain by an individual.
3. Individuals of varying demographics can benefit from gardening.

Recommendations for Additional Research

The following recommendations for additional research were made:

1. It is recommended to covary out the impact of income in this study to determine its influence on meeting physical activity requirements.
2. It is recommended analyzing a subset of older participants in this study to determine if results vary in an older population.
3. It is recommended that this study be replicated in a longitudinal manner in order to obtain a fuller understanding of the relationship and differences of gardeners and non-gardeners.
4. It is recommended a more in-depth study be conducted on gardeners with chronic illnesses.
5. It is recommended studies be conducted on gardeners and non-gardeners' fruit and vegetable consumption and incident of chronic illnesses.
6. It is recommended studies be conducted on gardeners and non-gardeners with chronic illnesses and perceptions of quality of life and incidence of diagnoses of depression symptoms.
7. It is recommended studies be conducted on gardeners and non-gardeners' activity/exercise frequency and perceptions of quality of life.

LITERATURE CITED

Agahi, N., K. Ahacic, and M.G. Parker. Continuity of leisure participation from middle age to old age. J. Geren. 61:340-346.

Ainsworth, B.E., W.L. Haskell, M.C. Whitt, M.L. Irwin, A.M. Swartz, S.J. Strath, W.L. O'Brien, D.R. Bassett, K.H. Schmitz, P.O. Emplaincourt, D.R. Jacobs, and A.S. Leon. 2000. Compendium of physical activities: An update of activity codes and MET intensities. Med. Sci. Sports Exerc. 32:498–516.

Alaimo, K., E. Packnett, R.A. Miles, and D.J. Kruger. 2008. Fruit and vegetable intake among urban community gardeners. Nutr. Educ. Behav. 40:94-101.

Allergy. 2015. In Merriam-Webster.com. 27 July 2015. http://www.merriam webster.com/dictionary/allergy.

American Academy of Allergy, Asthma and Immunology, (AAAAI). 2015. Allergy Statistics. 29 July 2015. <http://www.aaaai.org/media/resources/ media_kit/allergy_statistics.stm>.

Annesi-Maesano, I., A. Didier, M. Klossek, I. Chanal, D. Moreau, and J. Bousquet. 2002. The score for allergic rhinitis (SFAR): A simple and valid assessment method in population studies. Allergy 57:107-114.

Armstrong, D. 2000. A survey of community gardens in upstate New York: Implications for health promotion and community development. Health Place 6:319-327.

Austin, E., Y. Johnston, and L. Morgan. 2006. Community gardening in a senior center: A therapeutic intervention to improve the health of older adults. Therap. Rec. J. 40:48-56.

Berto, R. 2007. Assessing the restorative value of the environment: A study on the elderly in comparison with young adults and adolescents. Intl. J. Psych. 42: 331-41.

Bielory, L., D.P. Skoner, M.S. Blaiss, B. Leatherman, M.S. Dykewicz, N. Smith, G. Ortiz, J.A. Hadley, N. Walstein, T.J. Craig, and F. Allen-Ramey. 2014. Ocular and nasal allergy symptom burden in America: The allergies, immunotherapy, and rhino conjunctivitis (AIRS) surveys. Allergy Asthma Proc. 35:211-218.

Biophilia. 2012. In Merriam-Webster.com. 11 January 2012. http://www.merriam webster.com/dictionary/biophilia.

Blaiss, M.S., E.O. Meltzer, M.J. Derebery, and J.M. Boyle. 2007. Patient and healthcare-provider perspectives on the burden of allergic rhinitis. Allergy Asthma Proc. 28:4-10.

Boyer, R., T.M. Waliczek, and J.M. Zajicek. 2002. The master gardener program: Do benefits of the program go beyond improving the horticultural knowledge of the participants? HortTechnology 12:432-436.

Burges-Watson, D.L. and H.J. Moore. 2011. Community gardening and obesity. Persp. Public Health 131:163-164.

Butterfield, B. 2009. The impact of home and community gardening in America. National Gardening Assoc. 1-17.

Cammack, C., T.M. Waliczek, and J.M. Zajicek. 2002. The Green Brigade: The effects of a community-based horticultural program on the self-development characteristics of juvenile offenders. HortTechnology 12:82-86.

Carney, P.A., J.L. Hamada, R. Rdesinski, L. Sprager, K.R. Nichols, B.Y. Liu, J. Pelayo, M.A. Sanchez, and J. Shannon. 2011. Impact of community gardening project on vegetable intake, food security and family relationships: A community-based participatory research study. J. Community Health 37:874-881.

Center for Disease Control, (CDC). 2007. Prevalence of regular physical activity among adults-United States 2001-2005. Morbidity and Mortality Weekly Report (MMWR). V 56/46 1209-1212.

Center for Disease Control, (CDC). 2012. Trends in asthma prevalence, health care, mortality in the United States, 2001-2010.
http://www.cdc.gov/nchs/data/databriefs/db94.pdf

Center for Disease Control, (CDC). 2014. Overweight and Obesity. 15 June 2014.
http://www.cdc.gov/obesity/data/adult.html.

Center for Disease Control, (CDC). 2015. Facts about physical activity. 26 September 2015. http://www.cdc.gov/physicalactivity/data/facts.html.

Center for Disease Control, (CDC). 2015. Chronic disease overview. 27 September 2015. http://www.cdc.gov/chronicdisease/overview/#ref2.

Chang, V.W. and D.S. Lauderdale. 2005. Income disparities in body mass index and obesity in the united states, 1971-2002. Amer. Med. Ass. 165:2122-21128.

Clarke-Jones, J. 2004. Allergic rhinitis treatment reduces asthma attacks. Nursing Standard 28:8.

Coban, H. and Y. Aydemir. 2014. The relationship between allergy and asthma control, quality of life, and emotional status in patients with asthma: a cross-sectional study. Allergy Asthma Clinical Immun. 10:67-79.

Cotton, M. 1975. Effectiveness of horticultural therapy in lowering aggressiveness of institutionalized delinquent adolescents. Natl. Council for Therapy and Rehab. through Hort. Nwslt. 1:2–4.

Diette, G.D., N. Lechtzin, E. Haponik, A. Devrotes, and H.R. Rubin. 2003. Distraction therapy with nature sights and sounds reduces pain during flexible bronchoscopy: A complementary approach to routine analgesia. Chest J. 123:941-948.

Dishman, R.K. and M. Steinhardt. 1988. Reliability and concurrent validity for a 7-d re-call of physical activity in college students. Med. Sci. Sports Exercise 20:14-25.

Doxey, J., T.M. Waliczek, and J.M. Zajicek. 2009. The impact of interior plants in university classrooms on student course performance and on student perception of the course and instructor. HortScience 44:284-291.

Dravigne, A., T.M. Waliczek, R.D. Lineberger, and J.M. Zajicek. 2008. The effect of live plants window views of green spaces on employee perceptions of job satisfaction. HortScience 43:183-187.

Ellaway, A., S. Macintyre, and X. Bonnefoy. 2005. Graffiti, greenery and obesity in adults: Secondary analysis of European cross-sectional survey. Brit. Med. J. 331:61-61.

Finkelstein, E.A., I.C. Fiebelkorn, and G. Wang. 2004. State-level estimates of annual medical expenditures attributable to obesity. Obesity Res. 12:18–24.

Hammond, D., T.M. Waliczek, and J.M. Zajicek. 2009. The relationship between parental attitudes about children spending time outdoors and their children's overall health. HortTechnology 21:217-224.

Harvard Medical School. 2009. Medical dictionary. 6 September 2015. <http://www.health.harvard.edu/dictionary/B.htm>.

Haskell, W.L., I.M. Lee, R.R. Pate, K.E. Powell, S.N. Blair, B.A. Franklin, C.A. Macera, G.W. Heath, P.D. Thompson, and A. Bauman. 2007. Physical activity and public health: Updated recommendations for adults from the American college of sports medicine and the American heart association. Circulation 116:1081-1093.

Hawkins, J.L., J. Mercer, K.J. Thirlaway, and D.A. Clayton. 2013. ‘‘Doing’’ gardening and ‘‘being’’ at the allotment site: Exploring the benefits of allotment gardening for stress reduction and healthy aging. Ecopsychology 5:110-125.

Heerwagen, J.H. and G. Orians. 1986. Adaptations to windowlessness: A study of the use of visual décor in windowed and windowless offices. Environ. Behavior 18:623-639.

Hill, C.O. and P.D. Relf. 1982. Gardening as an outdoor activity in geriatric institutions. Activities, Adaptation and Aging 3:47-54.

Jansen, D.A. and V. Von Sadovszky. 2004. Restorative activities of community-dwelling elders. West J. Nurs. Res. 26:381-399.

Kaplan, S. and R. Kaplan. 1982. Cognition and environment. Praeger, New York.

Kaplan, R. and S. Kaplan. 1989. The experience of nature: A psychological perspective. Cambridge University Press, New York.

Kiyota, E. 2009. People-nature interactions: The therapeutic role of nature in elderly residents’ everyday experience in a long term care facility. ProQuest Dissertation and Thesis. The University of Wisconsin-Milwaukee. Milwaukee, WI.

Kopelaman, P.G. 2000. Obesity as a medical problem. Nature 404:635-643.

Lake, A. and T. Townshend. 2006. Obesogenic environments: Exploring the built and food environments. J. Royal Soc. Promotion Health 126:262-267.

Langellotto, G.A. and A. Gupta. 2012. Gardening increases vegetable consumption in school-aged children: A meta-analysis synthesis. HortTechnology 22:430-445.

Langer, E.J. and J. Rodin. 1976. Long-term effects of control-relevant intervention with the institutionalized aged. J. Personality Soc. Psy. 35:897-902.

Lewis, C.A. 1992. Effects of plants and gardening in creating interpersonal and community well-being, p. 55-65. In: D. Relf ed. The role of horticulture in human well-being and social development. Timber Press, Portland, OR.

Likert, R. 1967. The method of constructing an attitude scale, p. 90-95. In: M. Fishbein ed. Readings in attitudes theory and measurement. Wiley, NY.

Littman, A., E.J. Boyko, M.L. Thompson, J.K. Haselkorn, B.J. Sangeorzan, and D.E. Arterburn. 2014. Physical activity barriers and enablers in older veterans with lower-limb amputation. JRRD. 51:895-906.

Manaker, G.H. 1996. Interior plantscapes: Installation, maintenance, and management. 3rd ed. Prentice-Hall, Upper Saddle River, NJ.

Mather, M., L.A. Henkel, and M.K. Johnson. 1997. Evaluating characteristics of false memories: Remember/know judgement and memory characteristics questionnaire compared. Memory Cognition 25:826-837.

McGuinn, C. and P.D. Relf. 2001. A profile of juvenile offenders in a vocational horticulture curriculum. HortTechnology 11:427-433.

Microsoft. Microsoft Excel. Redmond, Washington: Microsoft, 2003. Computer Software.

Milligan, C., A. Gatrell, and A. Bingley. 2004. 'Cultivating health': Therapeutic landscapes and older people in northern England. Soc. Sci. Med. 58:1781-1793.

Moussavi, S. S. Chatterji, E. Verdes, A. Tandon, V. Patel, and B. Ustun. 2007. Depression, chronic diseases, and decrements in health: Results from the world health surveys. World Health Org. 370:851-858.

Murata, M. 2000. Secular trends in growth and changes in eating patterns of Japanese children. Am. J. Clin. Nutr. 72:1379–1383.

National Gardening Association. 2014. Garden to table: A 5-year look at food gardening in America. Harrison Interactive Inc. 2-13.

Nelson, M.E., W.J. Rejeski, S.N. Blair, P.W. Duncan, J.O. Judge, A.C King, C.A Macera, and C. Castaneda-Sceppa. 2007. Physical activity and public health in older adults: Recommendation from the American college of sports medicine and the American heart association. Med. Sci. Sports Exercise 39:1435-1445.

Nykamp, J. 1999. Gardening improves physical health, well-being. Holland sentinel. 10 Jan 2014. www.hollandsentinel.com/stories/010199/fea_gardening.html.

Ogden, C.L., M.D. Carroll, L.R. Curtin, M.A. McDowell, C.J. Tabak, and K.M. Flegal. 2006. Prevalence of overweight and obesity in the United States, 1999-2004. JAMA. 295:1549-1555.

Park, S.H. and R.H. Mattson. 2008. Effects of flowering and foliage plants in hospital rooms on patience recovering from abdominal surgery. HortTechnology 18:563-568.

Park, S., A. Lee, K. Lee, and K. Son. 2014. Gardening tasks performed by adults are moderate to high intensity physical activities. HortTechnology 24:58-63.

Parks, S.E., R.A. Housemann, and R.C. Brownson. 2003. Differential correlates of physical activity in urban and rural adults of various socioeconomic backgrounds in the united states. J. Epidemial Comm. Health 57:29-35.

Pate, R.R., M. Pratt, S.N. Blair, W.L. Haskell, C.A. Macera, C. Bouchard, D. Buchner, W. Ettinger, G.W. Heath, A.C. King, A. Kriska, A.S. Leon, B.H. Marcus, J. Morris, R.S. Paffenbarger Jr., K. Patrick, M.L. Pollock, J.M. Rippe, J. Sallis, and J.H. Wilmore. 1995. Physical activity and public health: A recommendation from the centers for disease control and prevention and the american college of sports medicine. J. Amer. Med. Assoc. 273:402-407.

Peeters, G., Y.R. Van Gellecum, J.G.Z. Van Uffelen, N.W. Burton, and W.J. Brown. 2014. Contribution of house and garden work to the association between physical activity and well-being in young, mid-aged and older women. J. Sports Med. 48:996-1001.

Rice, J.S. and L.L. Remy. 1994. Cultivating self-development in urban jail inmates, p. 229–257. In: M. Francis, P. Lindsey, and J.S. Rice (eds.). The healing dimensions of people-plant relations: A research symposium. Ctr. Design Rese., Dept. Environ. Design, Univ. Calif, Davis. Tougas, M. 1975. Project Mother Earth.

Riedler, J., C. Braun-Fahrlander, W. Eder, M. Schreuer, M. Waser, S. Maisch, D. Carr, R. Schierl, D. Nowak, and E. Von Mutius. 2001. Exposure to farming in early life and development of asthma allergy: A cross-sectional survey. Lancet 358:1129-1133.

Rothert, E.A. and J.R. Daubert.1981. Horticultural therapy for nursing homes, senior centers, retirement living. Chicago Hort. Soc., Glencoe, Ill.

Samuelson, G. 2000. Dietary habits and nutritional status in adolecents over Europe: An overview of current studies in the Nordic countries. Eur. J. Clin. Nutr. 72:1379-1383.

Sarola, J.P. 1994. Asuinympäristön ja paikan merkitys vanhalle ihmiselle. In: A. Uutela and J.-E. Ruth ed. Muuttuva vanhuus. Helsinki, Gaudeamus. 116-131.

Simons, S.P. and M.C. Straus. 1998. Horticulture as therapy. Food products press. Binghamton, NY.

Singh, K., S. Axelrod, and L. Bielory. 2010. The epidemiology of ocular and nasal allergy in the United States, 1988–1994. J. Allergy Clin. Immunol 126:778-783.

Skoner, D.P. 2001. Allergic rhinitis: Definition, epidemiology, pathophysiology, detection, and diagnosis. J. Allergy Clin. Immunol. 108:2-8.

Sommerfield, A.J., A.L. McFarland, T.M. Waliczek, and J.M. Zajicek. 2010. Growing minds: Evaluating the relationship between gardening and fruit and vegetable consumption in older adults. HortTechnology 20:711-717.

SPSS, Inc., 2009, Chicago, IL, www.spss.com.

Survey Monkey. 2015. Palo Alto, CA. www.surveymonkey.com

Seyedrezazadeh, E., M.P. Moghaddam, K. Ansarin, M.R. Vafa, S. Sharma, and F. Kolahdooz. 2014. Fruit and vegetable intake and rish of wheezing and asthma: A systematic review and meta-analysis. Nutr. Rev. 72:411-428.

Tappe, K.A and K. Glanze. 2013. Measrument of exercise habits and prediction of leisure-time activity in established exercise. Psy. Health Med. 18:601-611.

Taylor, M.K. 1990. The healthy gardener. Flower and Garden March. 46-47.

Turner, L.W., M.A. Bass, L.Ting, and B. Brown. 2002. Influence of yard work and weight training on bone mineral density among older U.S. women. J. Women Aging 14:139-145.

Ulrich, R.S. 1981. Natural versus urban scenes: Some psychophysiological effects. Environ. Behavior 13:523-556.

Ulrich, R.S. 1993. Biophilia, biophobia, and natural landscapes, p.73-137. In: Kellert, S.R. and E.O. Wilson. The biophilia hypothesis. Washington, DC. Island Press/Shearwater Books.

U.S. Department of Health and Human Services, (HHS). 2001. The surgeon general's call to action to prevent and decrease overweight and obesity. U.S. Department of Health and Human Services. 5 January 2014. www.surgeongeneral.gov/topics/obesity/calltoaction/cover.htm.

U.S. Department of Health and Human Services, (HHS). 2008. The president's council on physical fitness and sports. 5 January 2014. www.fitness.gov/resources_factsheet.htm.

Waliczek, T.M., R.H. Mattson, and J.M. Zajicek. 1996. Psychological benefits of community gardening. J. Environ. Hort. 14:204-209.

Waliczek, T.M., J.M. Zajicek, and R.D. Lineberger. 2005. The influence of gardening activities on consumer perceptions of life. HortScience 40:1360-1365.

Weisberg, S.P. 2002. Societal change to prevent obesity. 10 January 2014. www.ama-assn.org/sci-pubs/msjama/articles/vol_288/no_17/jms1106021.htm.

Willcox, R. and R.H.Mattson. 1979. Horticultural therapy maintains life-satisfaction of geriatrics. Great Plains J. Hort. Therapy 1:8–12.

Wilson, J.F. and K.M. Christensen. 2011. The relationship between gardening and depression among individuals with disabilities. J. Therap. Hort. 21:29-41.

Wing, R.R. 1999. Physical activity in the treatment of the adulthood overweight and obesity: Current evidence and research issues. Med. Sci. Sports Exercise 31:547-552.

Zampini, J.W. 1994. Down to earth benefits of people-plant interactions in our community, p. 185–191. In: J. Flagler and R. Poincelot eds. People-plant relationships: Setting research priorities. Haworth Press, Binghamton, NY.

Zick, C.D., K.R. Smith, L.K. Jones, C. Uno, and B.J. Merrill. 2013. Harvesting more than vegetables: The potential weight control benefits of community gardening. Amer. J. Public Health 103:1110-1150.

APPENDIX A

SURVEY

Garden Survey Questions

1. Do You Garden?**:** _____ Yes _____No

If you answered Yes to Question #1, please continue with question #2. If you answered No, please go to question #12. Please complete the rest of the survey.

2. Please check the type/s of gardening in which you engage. (Check all that apply)

Ornamental: _____ Vegetable: _____ Yard Maintenance: _____

3. Do you garden at:

_____ your home _____community garden _____ other

4. How long have you been a gardener? (Please check one)

_____ Less than 2 years _____ 11-15 years

_____ 3-5 years _____ 16-20 years

_____ 6-10 years _____ More than 20 years

5. How big is your garden? (Estimated square feet) _____

6. Please check **frequency** and **duration** of time spent in activity in the **Winter** (Dec., Jan., Feb) garden:

Frequency	**Duration**
_____ Most days	_____ <30 minutes
_____ 3-5 times a week	_____ 30-44 minutes
_____ Once a week	_____ 45-60 minutes
_____ 3-5 times a month	_____ # of Hours
_____ About once a month	_____Never
_____ Never	

7. Please check **frequency** and **duration** of time spent in activity in the **Spring** (Mar., Apr., May) garden:

Frequency	**Duration**
_____ Most days	_____ <30 minutes

_____ 3-5 times a week
_____ Once a week
_____ 3-5 times a month
_____ About once a month
_____ Never

_____ 30-44 minutes
_____ 45-60 minutes
_____ # of Hours
_____Never

8. Please check **frequency** and **duration** of time spent in activity in the **Summer** (Jun., Jul., Aug) garden:

Frequency
_____ Most days
_____ 3-5 times a week
_____ Once a week
_____ 3-5 times a month
_____ About once a month
_____ Never

Duration
_____ <30 minutes
_____ 30-44 minutes
_____ 45-60 minutes
_____ # of Hours
_____Never

9. Please check **frequency** and **duration** of time spent in activity in the **Fall** (Sept, Oct, Nov) garden:

Frequency
_____ Most days
_____ 3-5 times a week
_____ Once a week
_____ 3-5 times a month
_____ About once a month
_____ Never

Duration
_____ <30 minutes
_____ 30-44 minutes
_____ 45-60 minutes
_____ # of Hours
_____Never

10. Please check the kinds of gardening task performed at any time in the garden: (Check all that apply)

_____ Hand weeding
_____ Transplanting seedlings
_____ Digging
_____ Mulching
_____ Raking
_____ Other

_____ Mixing soil
_____ Filling containers with soil
_____ Turning compost
_____ Transplanting plants
_____ Pushing a mower

11. Please check the kinds of lawn maintenance task performed at any time in the garden: (Check all that apply)

_____ Fertilizing the lawn with a hand-spreader

_____ Fertilizing the lawn with a push-spreader
_____ Leaf Blowing/Sweeping
_____ Mowing the grass with a push mower
_____ Mowing the grass with self-propelled mower
_____ Mowing the grass with riding lawn mower
_____ Pruning/trimming shrubs/trees
_____ Weed eating/Edging
_____ Other

12. Please check other forms of physical activity/exercise in which you engage at any time of the year: (Check all that apply)

— Jogging
— Bicycling
— Weight training
— Aerobics
— Dancing/Zumba
— Swimming
— Walking/hiking
— Calisthenics
— Yoga
— Cross fit
— Martial Arts
— Organized sports
— I don't work out ever

13. Please indicate any other physical activities in which you participate for exercise/health benefits at any time of the year:

_____

_____

Please circle the answer that most closely applies to your exercise schedule <u>outside of gardening</u> for questions 14-21. Please Circle Not Applicable (N/A) for any question that does not apply to you.

14. My exercise location changes from day to day. Never Almost Never Sometimes Fairly Often Always N/A

15. I work out by myself. Never Almost Never Sometimes Fairly Often Always N/A

16. The time of day I work out varies from day to day. Never Almost Never Sometimes Fairly Often Always N/A

17. My exercise location differs on weekends and weekdays. Never Almost Never Sometimes Fairly Often Always N/A

18. I vary my exercise routine by performing different exercises on different days. Never Almost Never Sometimes Fairly Often Always N/A

19. Every day that I exercise, I perform the same exercise(s). Never Almost Never Sometimes Fairly Often Always N/A

20. I exercise with a partner. Never Almost Never Sometimes Fairly Often Always N/A

21. I exercised as part of a group (with two or more friends or as part of a class). Never Almost Never Sometimes Fairly Often Always N/A

22. The time of day I work out stays the same from day to day. Never Almost Never Sometimes Fairly Often Always N/A

23. My exercise location stays the same from day to day. Never Almost Never Sometimes Fairly Often Always N/A

Medical History Questions

24. Have you ever had reoccurring problems with any of the following health symptoms (Please check all that apply)?

— Limitations in any of the following activities due to health problems: riding a bike, running, or playing sports?
— Dizziness
— Body pain or discomfort
— Headache
— Chest Pain
— Neck Pain
— Back pain
— Frequent swollen glands
— Cough
— Short of breath
— Repeated upset stomach
— Constipation, loose bowels or diarrhea
— Weight loss of 10lbs or more
— Asthma attacks
— Itchy or watery eyes
— Colds
— Nasal congestion
— Ear infection or ear ache
— Sleep apnea
— Depression
— Feeling tired or having low energy
— Trouble sleeping
— Overweight/Obesity
— Diabetes
— Eating disorders
— High blood pressure
— Heart attack
— Stroke
— Poor circulation
— High cholesterol
— Kidney stones
— Kidney failure
— Anemia
— Blood clot
— Gout
— Ulcers
— Gallstones
— Pancreatitis

— Sore throat
— Anxiety
— Loss of appetite
— Osteoporosis
— Arthritis

Other: _____

25. Have you been diagnosed as having nasal allergies (hay fever), sinus disease, and/or allergic rhinitis? Yes No

26. Do you take any medication for nasal allergies (hay fever), sinus disease, and/or allergic rhinitis? Yes No

27. Have you had symptoms such as sneezing, itching, watery eyes, nasal congestion, or other nasal allergy symptoms in the past 12 months? Yes No

28. **Gender:** _____ Female _____ Male

29. **Age:**
_____ 18-22
_____ 23-29
_____ 30-39
_____ 40-49
_____ 50-59
_____ 60-69
_____ 70 +

30. **Weight (in pounds):** _____ **Height:** _____ ft _____ in

31. **Ethnicity:** _____ African American _____ Asian _____ Hispanic
_____ Native American _____ Caucasian _____ Other

32. **Annual Household Income:** _____ <15 K _____ 15-29K _____ 30-44K
_____ 45-59K
_____ 60-74K _____ 75-84K _____ 85-94K _____ >95K

33. **Highest Level of Education Achieved:** _____ Grade School Only
_____ Some High School
_____ GED/High School Degree
_____ Some College
_____College Degree
_____Post Graduate
_____Trade School

34. **State in which you reside: _____**

35. **Description of your residence:** _____Rural _____Suburban _____ Urban
_____ Inner City