Harvesting Healthier Generations: Improving Childhood Health Through School Gardens and Farm-to-Cafeteria Lunch Programs

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Harvesting Healthier Generations: 
Improving Childhood Health Through School Gardens and Farm-to-Cafeteria Lunch Programs

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Abstract

This report explores the current childhood obesity health crises in the United States and the potential solutions of school garden and farm-to-cafeteria lunch programs. The study of school garden and farm-to-cafeteria lunch programs investigates an environmental problem from a health outcomes perspective. Previously published, accredited scientific articles are systematically reviewed to identify both the success and failures of these programs, in addition to defining areas needing greater research. The research and data collected in the systematic review is later used to suggest a set of best practices for school garden and farm-to-cafeteria lunch programs. School garden and farm-to-cafeteria lunch programs offer viable solutions for the obesity epidemic that necessitates a change.
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Preface

Growing up in a restaurant kitchen has inspired me to investigate the current failures of our food system and built environment. Spending my childhood in my father’s restaurant has taught me a love and appreciation for the value of food and nutrition. I believe that all children should be provided with the opportunities to experience and understand the significance of food and our diets. The coupling of my values of food and environmental morals greatly contributes to the selection of conducting research on school garden and farm-to-school lunch programs. The childhood obesity epidemic exemplifies the disconnect between, our bodies, our food, and our environment. The discovery of my research question did not grow in a vacuum, but derived from the intersection of my personal values and academic interests that characterize this thesis report.
**Introduction**

This thesis will identify methods to improve childhood health in the United States through a systematic review of fourteen school garden and “farm-to-cafeteria” lunch programs. Following the systematic review, the effectiveness of each selected study will be evaluated and compiled into a best practices recommendation. The systematic review and best practices presented will strive to provide comprehensible, straightforward, and clear findings in order to ensure functionality.

A comprehensive background of nutrition, childhood health, and education system in the United States will be provided to ensure a well-developed understanding of each facet of improving childhood health through school lunch programs. Following the background, I will outline the methods I have developed to conduct my research. The results I have collected will then be presented along with a discussion of my findings. Finally, I will draw my conclusions and provide recommendations for future school lunch programs and research.

Policy makers, school administrators, schoolteachers, and parents will depend on the practicality of the provided best practices for the implementation of school gardens and farm-to-cafeteria lunch programs intended to improve childhood health in the United States. This thesis is intended for my peers at The University of Colorado Boulder. It is my hope that these findings will inspire my peers to encourage change in the United State’s school lunch agenda. This thesis is one step to help educate and motivate my peers to help solve the undeniable presence of obesity among children, which demands adjustment, in the United States.

**Background**

Children across the United States are experiencing a life-threatening health epidemic suffering from obesity at an unprecedented rate. Practices must radically change in the United
States in order to improve children’s dietary patterns and eradicate obesity and obesity related illness. Establishing effective, feasible, and successful solutions are crucial for the future health of the country.

**Definition of Health**

Health can be interpreted and defined in a number of different ways. For the purpose of this study it is necessary to establish the meaning of health that will be applied and referred to throughout the discussion of childhood health in the United States. Although many ideas of health exist, this thesis will be circumscribed to the definition of health using the World Health Organization’s criteria because it is a widely accepted and standardized definition. Good health, defined by the 1946 Constitution of the World Health Organization, is a state of total physical, social, and mental well being, and not simply the nonexistence of disease or infirmity.¹ Health is considered by the World Health Organization to be a universal right. The acknowledgment of the universal right to health is essential to document in the context of this thesis because many American children are being deprived of this fundamental right through the education system. It is recognized that health is an element necessary for everyday life built on the positive maintenance of social and personal resources, in addition to physical capabilities.¹ Health greatly contributes to a nation or population’s economic development and internal stability.¹ It is not limited to only affecting the morbidity or mortality of an individual, but also acknowledges the dualism of the self and the body.² Despite the innumerable interpretations of health, the definition provided by the World Health Organization attempts to encompass the multitude of facets of health.

Acknowledging the successes or defeats achieving health requires the identification of

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factors influencing health. The World Health Organization describes determinants of health as a force or element that negatively or positively impacts health. Intrinsic and extrinsic forces affect an individual’s quality of health.¹ Intrinsic forces include genetics, behaviors, culture, habits and lifestyles.¹ Contrary, extrinsic forces are preventative, curative, and promotional aspects of the health sector, in addition to elements beyond the health sector such as, economic, social, environmental, and technological factors.¹ Both intrinsic and extrinsic forces can be illustrated through the prevalence of childhood obesity. Maintaining good health is not exclusive to the upholding of one, single component, but instead is reliant on many factors.

**Nutritional Health**

Nutritional health is among many factors needed to maintain good health, but it is especially important to understand in the consideration of improving childhood health through school gardens and farm-to-cafeteria lunch programs. It is necessary to acknowledge the definition of nutritional health and how children can obtain good nutritional health before moving forward. The United States Center for Disease Control and Prevention offers a complete definition of nutrition and recommendations for healthy nutrition among young people. The definitions and standards provided by the United States Center for Disease Control and Prevention (USCDC) will be used in this thesis and systematic review to evaluate affective methods improving childhood health.

In the Dietary Guidelines for Americans, provided by the US CDC, it is recommended for children aged two years or older to have a diet rich in fruits and vegetables, whole grains, and fat-free or low-fat dairy products. Intake of solid fats, cholesterol, sodium, artificial sugars, and refined grains should be limited and minimal. According to the USCDC, each day children should have two-and-a-half to six-and-a-half cups of fruits and vegetables and two to three ounces of whole grains to ensure a health diet. In addition to these recommendations, diets
should avoid consuming more than 1,500-2,300 mg of sodium each day, and minimize eating empty calories from sources such as, soda, grain desserts, pizza, fruit drinks, dairy desserts, and whole milk. The recommendations provided by the USDC have proven to improve health of children. Abiding by the USCDC’s guidelines promotes successful growth and development of children; prevents high cholesterol, high blood pressure, and the risk of chronic diseases such as, cardiovascular disease, cancer, and diabetes; and reduces the risk of developing obesity, osteoporosis, iron deficiency, and dental cavities. The nutritional health successes demonstrated through the adaptation of the USDC’s guidelines greatly contributes to the reasons why these standards will be used in this thesis to determine healthy lunch programs.

**Mental Health**

As noted by the World Health Organization, health can be applied beyond the parameters of the physical body to the self of an individual. School gardens and farm-to-cafeteria lunch programs not only have ability to influence nutritional health, but also impact areas of mental health. The facets and measurements of mental health among children affected by school gardens and farm-to-cafeteria lunch programs must established to effectively measure the benefits of lunch programs. Quantifying and defining the measurements of mental health benefits of school gardens and farm-to-cafeteria lunch programs, unlike nutritional health, has proven to be a challenge, allowing for any shifts or changes in mental health to be noted in the systematic review.

After thoroughly researching for my background, three major themes contributing to mental health improvements are encountered through the participation of school gardens and farm-to-cafeteria lunch programs: academic achievement, psychological development, and

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exposure to natural environments. Academic achievement and connectedness to school reduces the occurrence of health-risk behaviors such as, socially disruptive actions and anxiety or depressive symptoms.\(^4\) Connectedness to school can be evaluated by measuring quality relationships, engagement in learning, and emphasis on lessons teaching health and well being.\(^4\) Changes in academic achievement can be understood through standardized test scores and grade point averages. Additional improvements in mental health can be achieved through small satisfying experiences that elicit physiological growth and development.\(^5\) Psychological development is achieved and can be measured through increases in self-awareness, self-acceptance, and social integration.\(^5\) Exposure to natural environments, experienced through school gardens, have the ability to improve mental health. The intrinsic qualities in a natural environment have been connected to enhancing well being and health.\(^6\) Assessing specific health outcomes as a result of outdoor experiences is typically dependent on self-reported measures of emotions.\(^6\) The mental health benefits of school gardens and farm-to-cafeteria lunches must be acknowledged, in addition to nutritional health in order to provide a comprehensive, whole study.

*Applying the Definitions of Health*

The definitions and measurements of health provided will be applied to all future assessments and reviews of improvements in childhood health through school gardens and farm-to-cafeteria lunch programs in this thesis. The standardization and acknowledgment of these definitions and measurements of health allow for consistency throughout the background and


data collection for the systematic review. It is important to consider that the meaning of health can vary greatly, but for the purpose of this study it is confined to a particular definition and measurement. The establishment of the scope of this study now allows for further discussion of how childhood health in the United States can be improved through school gardens and farm-to-cafeteria lunch programs.

**History of Food**

Human life and health is dependent on the existence of food. It has had a crucial role in life since the beginning of existence. Food has been a constant commodity since the beginning of human life, but societies’ relationship with food is ever changing. Most of the evolutionary changes in civilization have revolved around changing dietary and nutritional conditions. Every food has an effect on the body and carries a medical significance. Understanding the importance of food and the shifting relationship with food and helps to explain how the current childhood obesity epidemic in the United States has exploded.

Food systems began with the Neolithic transformation, where agriculture emerged and dominated. Only a few thousand years later, the globalization of food systems has conquered Western civilization. This rapid transition has greatly affected individual’s relationships with food. During the nineteenth and twentieth centuries, the consumption of sugar increased resulting in a notable decrease in nutrition. This phenomenon has been accelerated with the introduction of food technology and fusing of agricultural and chemical businesses. In past food systems humans have eaten what is good for them until recently. Shifts in the food system include, the

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increase of already-prepared food, desecilization during meals, the disappearance of the structured meal, and increased snacking. These changes in the food system are expected to have considerable social implications.

Food defines human identity because an individual is created biologically, psychologically, and socially by the food that is consumed. The human diet has the ability to reflect cultural, economical, behavioral, and other individual affiliations or characteristics. Food can never be considered ‘just food’, nor can it only be attributed to nutrition. Food and dietary habits are part of a complex system relating to, palate, identity, culture, affordability and more. The intricacy of such a system is essential to recognize because it reflects the many barriers preventing change in the food system. Each element of the food system is made up of many components having an overarching reach on many facets of life.

The acknowledgment of food and its important role in civilizations since the beginning of life contributes to societies’ relationship with food today. The nutritional and social changes of food that have recently occurred must be associated to the growing appearance of obese and overweight children. The obesity crisis among children in the United States illustrates a dramatic shift in one facet of the food system.

**Childhood Nutritional Health Today**

Understanding the root causes of poor childhood nutrition in the United States are necessary to protect future generations from the further proliferation of illness and obesity related illnesses. Obesity is most commonly attributed to a surplus of dietary intake relative to energy expenditure or physical activity. Despite the incredible medical and health advances in science, the country is experiencing a troublesome setback because of childhood obesity.

More children than ever are suffering from nutritionally related illnesses. 15 percent of
American children are obese and 33 percent are considered overweight. Obesity and overweight are terms employed to indicate body weights that exceed generally considered healthy weights relative to height. Obesity among children implies a body mass index at or above the 95th percentile for children of the same age and sex and overweight among children is defined as a body mass index at or above the 85th percentile and below the 95th percentile for children of the same age and sex. The body mass index (BMI) is measured using a child’s weight and height, but it does not quantify body fat directly. The prevalence of obese and overweight children has tripled over the past thirty years. African American, Hispanic, American Indian and low-income children are disproportionately affected by obesity. Nearly one in two African American and Hispanic children suffer from obesity or are overweight. Children suffering from obesity and obesity related illnesses are expected to experience a variety of health and social disadvantages.

Obesity and severe weight gain are related to and cause many health problems including, increased blood pressure dyslipidemia and high cholesterol, strain on weight-bearing joints or musculoskeletal pains, heightened risk of type 2 diabetes, breathing or respiratory challenges,

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such as asthma, cardiovascular disease, pulmonary disease, and shortened life expectancy.\textsuperscript{16-17} Early onset of childhood obesity and extreme weight gain is significantly linked to more severe adulthood obesity and associated morbidities in adults.\textsuperscript{16-17} Obese children are 77 percent more likely to become obese adults.\textsuperscript{18} In addition to physical health problems, obese and overweight children are more susceptible to discrimination, low self-esteem, social stigmatization, depression, functional difficulties, lower education achievement, and expected reduced future earnings.\textsuperscript{16-17} Obesity not only impends the health of children, but it also threatens the livelihood of the future generations of the United States.

Additionally, genetics, psychology, social, economic, environmental and political factors influence one’s vulnerability to obesity. Identifying unambiguous traits of the United States food system illustrates how and why obesity has dramatically increased among children.

Shifting characteristics of the food system and built environment have greatly contributed to the rising number of obese and overweight children.\textsuperscript{19} The affordability and accessibility of high fat content and caloric food has significantly contributed to the obesity epidemic.\textsuperscript{19} The presence of processed, non-perishable, and pre-packaged foods, usually high in fat, sodium and sugar, have increased.\textsuperscript{19} The pre-packaged, non-perishable foods are easily prepared, convenient, and come at low-cost giving rise to their popularity.\textsuperscript{19} Fast food restaurants, bodega or convince stores, and vending machines are virtually everywhere filled with inexpensive, high-caloric food options. Commercial proportion sizes have significantly increased and can be two to eight times


larger than standard serving sizes determined by the United States Department of Agriculture or Federal Drug Administration. This encourages the purchaser to consume more thus accounting for an increased intake of highly caloric foods. These products are not only extremely palatable for children, but are also marketed and advertised to children. The food made available to children is clearly not providing nutritional value, but instead is supporting obesity.

In addition to the overwhelming presence of unhealthy food marketed to children, declining levels of physical activity contribute to the obesity epidemic. Reasons for less physical activity levels include: a decrease in access to physical activity due to things such as; fewer sidewalks; minimizing physical education time in school; and increased sedentary time watching television, playing video games, or using other electronic forms of entertainment. Physical activity is an essential component to maintain a healthy weight, especially when considering the diet children today have.

An increase in the consumption of unhealthy foods combined with a decrease in physical activity is a recipe for disaster. Many changes in our society and food system offer explanations that describe why obesity is on the rise, but it is crucial for the health of future generations to identify solutions. The growing unprecedented occurrence of obese and overweight children demands an intervention.

**Improvement of Childhood Nutrition**

The appearance and threat of childhood obesity in the United States is undeniable and necessitates change. Cultural, behavioral, physical and social factors must be addressed and are

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suggested areas for successful intervention.21 Nutritional standards that support nourishing, clean, safe, and developmentally appropriate are essential to identify and implement.22 The improvement of childhood health is dependent on a variety of changes, but refining the food children consume is crucial.

Classifying nutritional foods for children is the first step to ensure children’s health and the avoidance of childhood obesity. Suggested foods include: whole grains, dark green leafy, and deep yellow vegetables, dark orange, yellow, and red fruits, 100 percent fruit juices, but juices should be limited to only four to six ounces per day, whole or reduced fat milk, unsweetened low-fat yogurt, low-fat cheese, baked or broiled chicken, fish, lean meats, dried peas and beans, and lastly vegetable oils.22 The diet of children should incorporate these nutritious proteins, carbohydrates, and oils to ensure a well-balanced healthy meal. A consistent and regular diet comprised of these kinds of food is necessary to support health. The attractiveness of food or meals also plays an instrumental role in the promotion of healthy eating habits.22

Recognizing wholesome, healthy foods and learning how to make these products more appealing to children has the ability to restructure the United State’s food system. Utilizing nutritional ingredients and making healthy food attractive to children may be considered a simple solution, but ensuring these kinds of foods accessibility to children proves to be a challenge. Healthy, nutritional foods should be supplied and easily accessible for children in all settings.

**Children in School**
Children spend a significant amount of time and eat a considerable amount of meals at

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school rendering it an ideal forum for food intervention. 56 million children attend elementary, middle, and high school for eight hours a day, five days a week, and eight months of the year from ages five to eighteen.\textsuperscript{10} 23.5 million children, nearly half of the children enrolled in school, qualify for subsidized or free meals provided by the public school system and are guaranteed food. School lunches should provide 33 percent of students’ energy intake, but only provide 19 percent because of the sale of competitive foods.\textsuperscript{23} It is evident that public schools provide a substantial amount of food children in the United States. The ability to address an incredibly high concentration of children in one arena through school is notable and should be taken advantage of.

School is an ideal place to introduce nutritional foods, not only because of the capability to reach a large capacity of children, but also because dietary patterns are developed at young ages. Obese lifestyles that occur before kindergarten are expected to continue throughout one’s life course causing a greater need for immediate intervention through one of the first socialization experiences at schools.\textsuperscript{24} Intervention at younger ages can reduce the trajectory of obesity in adulthood. In other social infrastructure realms it may be difficult to interfere with young children’s dietary patterns because of their lack of social capital, but schools are one structure where young children can be reached. The school setting provides the opportunity for a beneficial coupling of health education and the supply of healthier foods.

Intervention through a school setting will extend and reach more than just students. 4 million elementary and secondary school teachers and hundreds of thousands of school employees including, janitors, administrators and more will also be educated and affected by


food reforms in the school. Additionally, students will share their experiences and knowledge with their families extending the impact of school programs. Public schools have the ability to be regulated, monitored, and funded through the government. These features provide an opportunity for a countrywide reformation of childhood obesity, and even adulthood obesity, if improvements and additions to current policies are implemented.

**History of School Food System**

School food programs are failing to provide children with the healthy diet and lifestyle necessary for success. Currently, federal nutritional regulations that are designed to protect the quality of school food are often counterproductive and unhealthy. Schools add sweeteners or flavors to milk in order to meet required calorie minimums, but policies like this have unintended consequences. Although this particular regulation guarantees that a product ha a certain number of proteins, it does not guarantee that it is nutritional. Additionally, the presence of competitive foods on school campuses also inhibits a child’s ability to make healthy decisions and gain nutritional value. Competitive foods include candy, cookies, soft drinks, pizza, and other very palatable options for children. These items are typically sold via vending machines or a la carte and, virtually, give students no nutritious choices. If children are unable to access healthy food at home, then it should be made available at school without competing choices.

School food programs have become industrialized, mirroring the United State’s current food system, resulting in an increase in processed foods and a decrease in fresh foods. Many schools lack adequate kitchen utilities because there is no longer a need to cook. Pre-packaged food is supplied to the school and only requires heating up. Obesity among students has proven to decrease through the implementation of policies that eliminate unhealthy foods and nonnutritive competitive foods. The achievement of mandatory universal policies removing the

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presence of unhealthy foods for the substitution of nutritional foods across the United States could result in nation-wide success reducing childhood obesity.

**Call for Change of School Food System**

The failure to provide children with fresh, appealing, and nutritional meals at school has resulted in a childhood obesity epidemic. Dietary habits are shaped and defined during childhood years and continue throughout adulthood stressing need for change in the school food system. Attitudes regarding food, eating behaviors, and food habits, are constructed through early-age food and eating experiences. Caregivers, schoolteachers, and food service administrators are responsible for the well being and health of the country’s children, but it appears that these actors are promoting the opposite.

The ability to learn nutritional eating habits and maintain a healthy weight can be taught effectively through the education system. Teachers have the opportunity to provide children a healthy example by modeling exemplary mealtime behaviors. Education programs can supplement healthy meals lending to healthier eating patterns. Declining childhood health is evident, and solutions to improve health have been identified, but how to implement these practices proves to be an unanswered challenge. In response to recent accelerated obesity rates, school gardens and farm-to-cafeteria school lunch programs are thought to have the power to initiate nutritional change in children across the United States.

**Definition of School Garden**

School gardens are created to yield a supply of fresh produce, achieve a hands-on education, and provide a source of physical activity. Fruit and vegetable consumption among children is low in the United States, but school gardens would help to address this deficiency.

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Studies suggest that those who garden have healthier diets than those who do not.\textsuperscript{27} In addition to the nutritional value of fruits and vegetables, increased intake of fruits and vegetables can decrease one’s vulnerability to chronic disease.\textsuperscript{27} School gardens can provide easy access to the nutrients and healthy foods the children of the United States deserve and need to promote successful futures.

School gardens will not only provide access to fresh produce, but it will also give children the opportunity to gain knowledge and experience nature.\textsuperscript{27} Through gardening students will be able to learn about ecological systems, nutrition, and wellness positively shaping their dietary habits for a lifetime.\textsuperscript{27} The educational benefits presented through school gardens are among many of the ideal benefits of school gardens and these lessons are a valuable bonus. Fulfillment, independence, and motivation are also among lessons children will gain from school garden participation.\textsuperscript{28} Engagement in gardening also promotes physical activity.\textsuperscript{27} The lessons learned from school gardens are innumerable and present a variety of social, health, and educational benefits. School gardens provide fresh, nutritious produce, physical activity, and education to children countering obesity and other poor nutrition related illnesses.

**Definition of Farm-to-Cafeteria Lunch Program**

Farm-to-cafeteria lunch programs aim to serve locally and sustainably grown food by purchasing fresh food directly from local farmers to improve the quality and taste of meals served at school.\textsuperscript{29} The mission of farm-to-cafeteria programs is to encourage students to better their eating habits and health through improved quality of food.\textsuperscript{29} These programs can encourage students’ access to fresh produce and products and can replace the supply of competitive foods.

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Improving the quality of food provided to schoolchildren can drastically improve childhood health problems associated with obesity and other associated illnesses.

Farm-to-cafeteria lunch programs not only concentrate on enhanced quality of food, but also showcase the beauty and benefits of local food. Farm-to-cafeteria lunch programs have the ability to serve attractive meals because of local farmers’ care for their products and smaller-scale tasks, which, as discussed earlier, is an influential component to encourage children to eat healthy foods. The attractiveness of a product greatly influences a child’s response to the food.\textsuperscript{10} Consuming locally grown food is also a reminder of the seasons and connects children to their environment.\textsuperscript{29} Farm-to-cafeteria programs will also reduce food miles and improve local economies having an advantageous side effect for both the environment and economy. Local produce used in farm-to-cafeteria programs is typically fresher, more nutritious, and more cost effective compared to produce from around the country or abroad.\textsuperscript{29} The benefits of farm-to-cafeteria lunch programs are plentiful and valuable to the success of healthy children.

Farm-to-cafeteria lunch programs have the ability to simultaneously improve, the health of children, environmental attitudes of children, the local economy, and the environment. The triumph of farm-to-cafeteria lunch programs is essential to recognize. Schools that have already participated in these programs have noted an increased intake of fruits and vegetables between 25 percent and 84 percent.\textsuperscript{29} Improvements in fresh produce intake are among many. The successes of farm-to-cafeteria lunch programs are indisputable mandating for the implementation of these kinds of programs.

\textit{Beyond Nutritional Benefits}  
The benefits of school garden and farm-to-cafeteria lunch programs extend beyond nutritional improvements among participating children. Today children’s experiences with the
complexity and beauty of the natural ecosystem are absent.\textsuperscript{30} In 2006, The United States Department of Agriculture found that 83 percent of the population lives in urban settings where nature and wilderness are no longer a normative experience.\textsuperscript{30} Environmental exploration has been replaced with television, the Internet, video games, and organized sports (Blair, 2005). Few children are able to have positive experiences with natural environments due to urban sprawl and environmental degradation.\textsuperscript{30} Schools, which were once considered a facilitator of exploration, have limited children’s exposure to nature through asphalt-covered playgrounds and monocultures of flat green fields.\textsuperscript{30} School gardens have the ability to transform the scenery, aesthetics, and environment of an academic setting through the installation of horticultural consisting of: potted plants, lifted garden beds on asphalt, indoor vermiculture composting, and direct in-ground planting.\textsuperscript{30} Each of these installations of school gardens cultivates academic, social, political, behavioral, recreational, and environmental lessons in addition to improving the health of participants.\textsuperscript{30} Increased sense of belonging, self-esteem, compassion and the ability to identify the school garden as a visible community asset, which is an associated political benefit, are all among specific improvements of children’s well being through the participation of school gardening. Gardens are a reminder of natural processes such as, growth and decay, seasons, precipitation, pollination, soil composition, carbon cycles, predator-prey relationships, and myriad life.\textsuperscript{30} Farm-to-school lunch programs further emphasize the value and delicateness of the environment by illustrating nature as a nurturing entity and reciprocating relationship rather than an anthropogenic outlook on nature. The, arguably, most necessary academic lesson promoted through school gardens is environmental education.

Definition of Environmental Education

Without a doubt education is the key to success. Education provides information and knowledge through the process of instruction. The lack of environmental education has certainly contributed to the defeats of the environmental movement. Environmental education is composed of many facets representing the diversity of the field. The United States Environmental Protection Agency (U.S. EPA) defines environmental education as a process that facilitates the exploration and critical thinking of environmental issues. Environmental education provides individuals with the skills to make knowledgeable and rational decisions about environmental issues. It is composed of awareness and sensitivity of environmental problems; knowledge and understanding of environmental challenges; attitudes of concern for environmental quality; tools to identify and resolve environmental problems; and involvement in activities that lead to the resolution of environmental challenges. Environmental education is more than a collection of facets and information, it provides public awareness, teaches critical thinking, and reinforces decision-making skills, but it is important to recognize that, as defined by the U.S. EPA, environmental education is not a proponent of a particular perspective or of a particular course of action.\(^\text{31}\) Students should be exposed to the plurality of environmental education, so they can critically think and develop their own environmental values and attitudes.\(^\text{32}\)

The intended purpose of environmental education is to develop a more aware generation interested in investing in the importance and value of the environment that is currently being deteriorated and threatened due to anthropogenic sources. It is obvious from the United State’s


recognition of environmental education that it is a proponent of the environmental movement and deemed a necessary tool by the United State’s government for environmental success and the development of sustainable future generations.

Significance of Childhood Environmental Education

The goal of environmental education in pre-school and elementary school is not to burden young children with distant and, often, dismal environmental problems, but instead to increase awareness in hopes of a greener generation. Implementing environmental education programs at a younger age is particularly important because childhood is a time of crucial development in each area of the personality. About half of one person’s academic potential is developed during pre-school and early childhood. Attitude structures are well developed by the end of high school and key changes happen in the younger years. In addition, children are particularly susceptible to environmental education because they are amazed by nature’s beauty and greatly appreciate a clean, healthy, and attractive environment. The interaction with nature at a young age is pivotal for environmental attitudes and success. In a study conducted by Chawla et al., 80 percent of those who participated identified childhood experiences of nature as significant. Environmental education for younger students is of great importance for the health of the environment in future years because people with a greater personal sense of competence and a belief in their collective competence are more likely to be politically engaged. Environmental success depends on political activism and engagement, which, would be an outcome of environmental education. Studies and literature confirm that there is a clear correlation between the achievement environmental education and children students. The implementation of


environmental education programs, such as school gardens, not only has the ability to improve the health of children, but also protect and remediate the environment.

Methods of Implementing Environmental Education

It is not enough to simply educate, but instead strategic actions must be taught in order to stimulate affective results. In order for environmental education to be successful in motivating attitudes, programs must be part of a comprehensive curriculum for many years. Environmental education methods include: experience based environmental education; hands-on activities; play-based lessons, and exposure to nature media and text. Both school gardens and farm-to-cafeteria lunch programs have the ability to incorporate these effective methods of environmental education.

Experience and interactions with the environment allow students to connect more with nature and its importance. Children that experience hands-on activities with the environment, such as planting trees, were delighted, interested, and satisfied. Consequently, it can be understood that children appreciate, perhaps more than adults, interactions with the environment. Experiences with nature, through activities such as, gardening, greatly influence the relationship students will have with the environment. As a result, one’s concern for environmental quality will be affected. Outdoor education or experience education can vary greatly in setting and content and actively engages students in the material being taught. In young children’s learning it is important to not only have these experiences connect with nature, but also connect these experiences with knowledge. Hands-on learning, through gardening or

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actively eating locally and sustainably grown food, also provides an opportunity to integrate
skills and knowledge from different areas. As a result, students are more likely remember the
lesson and apply the skills to new situations. Farm-to-cafeteria lunch programs have the ability
to connect lessons taught through school gardens to practical life experiences. Children will have
the opportunity to understand the importance of eating locally and growing sustainable crops
through farm-to-cafeteria lunch programs.

Play-based learning seeks to reduce the gap between teaching and the actual
implementation of environmental attitudes outside of the classroom. Play-based education is
essential because it allows exploration and discovery. Play-based environmental education
includes both open-ended play, modeled play, and purposefully framed play. Open-ended play
provides the students with supplies suggestive of environmental/sustainability views and with
minimal teacher interaction; the student is able to discover and explore the ideals of
environmentalism. Modeled play experiences are led by the teacher who illustrates, explains, and
demonstrates the use of the suggestive environmental/sustainable supplies prior to exposing the
children to these supplies. Finally purposefully framed play combines both open-ended play and
model play. First, there is open-play where the teacher supplies the suggestive supplies of the
environmental and sustainable concept, followed by model play and lastly teacher-child
engagement. These methods are emphasized and supported by school gardens and farm-to-
cafe system lunch programs. Farm-to-cafeteria lunch programs and school gardens can further play-
based learning by collaborating or developing partnerships with university forestry divisions, city
urban planners and naturalists, public health officials and local businesses to facilitate knowledge
of the study of natural resources and healthy lifestyles.

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years of place and play-based lessons, including interactions with local environmental community members and with local gardens, improved standardized test scores in math, language arts, social studies, and science among fourth-grade students in a low-income, rural, and predominantly African-American, Louisiana school district. Play-based environmental education allows emphasis to be on both experience and knowledge and bridges the gap between academics and actions.

Teaching environmental knowledge through exposure to nature films and books results in stronger environmental attitudes. The inclusion of nature film, books, and texts are especially significant because of the continuous and considerable amount of exposure. The majority of media coverage presents an ecosystem associated with strong conservation ethics. It is key to teach students how to interpret these ethics so they can form their own values regarding the environment. Using the media and real-life examples to illustrate environmental challenges allow the student to apply their knowledge. Farm-to-cafeteria lunch programs exemplify real-life examples and can be accompanied with education pamphlets regarding the both the nutritional and environmental impact of menu items. Short-term exposure to environmental film and books will not be effective, but long-term exposure and discussion of these forms of media prove to be beneficial in adjusting or forming environmental attitudes. Students will be able to learn knowledge of issues, knowledge of action strategies, and an individual sense of responsibility through the combination of media and class discussion through school garden and farm-to-cafeteria lunch programs. From these findings, the significance of applying knowledge learned in the classroom to practical experiences can be clearly understood.

Each methodology detailed serves an important purpose in environmental education, but

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this compilation does not include all methodologies introduced or created. These unique methodologies are developed in hopes of teaching young students practical ways to be environmentally conscious, especially through school gardens and farm-to-cafeteria lunch programs.

**Employing Environmental Education**

Environmental education works to teach, resolve, and explore environmental challenges, but is it truly successful in generating healthier environmental attitudes and practices? Is the health of the environment and of children dependent on the implementation of environmental education? In an environmental education report conducted by the state of Washington studying grades K-12, environmental education is found to be able to effectively educate students about environmental challenges. As a result of environmental education, students reported that they were more willing to take actions to solve growing environmental problems. Another study conducted by Lieberman and Hoody (1998) found that classrooms that integrated the environment had a 92 percent increased interest for learning, high standardized test scores, and better grade point averages compared to classrooms that did not have any environmental education programs. According to The National Environmental Education and Training Foundation, engagement with the environment supports learning that is problem-based and interdisciplinary. After reviewing the literature, there is no doubt that environmental education plants the seed for sustainable living, eco-friendly attitudes, and healthier lifestyles. Each methodology discussed has found that environmental education is an essential ingredient for the future health of our environment; but if this missing ingredient is so important for environmental and educational success why isn’t more being done?

Effective environmental education can be accomplished, but it demands a great deal of change. The most effective methodologies must be prioritized and then developed into a
curriculum easy for educators to implement. Educational policies or teaching standards need to include environmental education in the curriculum for success, but this is not possible until further research confirms which methodologies are best. After the inclusion of environmental education in policy, teachers must be well educated in the specific programs. Professional development can be achieved through a variety of means; some include, summer institutes or workshops, biweekly learning sessions, online seminars, and more.

Conceptual, logistical, attitudinal and educational barriers are expected to occur in attempts to introduce environmental education. Each of these barriers must carefully be considered to avoid failure. Conceptual barriers result from the lack of unanimity about the range and content of environmental education. Logistical barriers stem from a lack of time, funding, instructional resources etc. Teachers’ personal attitudes may negatively affect or prevent environmental education resulting in attitudinal barriers. Lastly, educational barriers may occur depending on the teachers’ competency to conduct environmental education programs. The barriers facing environmental education are large, but can be accomplished if an increase in participation, action, and demand ensues.

**Answering the Call for Change**

Problems have been identified and effective solutions have been presented. Improving the current school food system with school gardens and farm-to-cafeteria lunch programs can reduce childhood obesity while promoting environmental values. If these solutions have been recognized, then why haven’t they been implemented? There are many social, political, and economical barriers preventing the employment of these programs. Social obstacles can include:

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the absence of teachers’ interest, understanding, experience, and skill in gardening; no teacher training in gardening; lack of time to garden; and scarcity of curricular materials connected to academic standards.\textsuperscript{41-42} Economic challenges may consist of: lack of funding and little access to gardening supplies. The United States Department of Agriculture (USDA) does not have the ability to regulate products sold outside of the cafeteria or beside mealtime food and beverages.\textsuperscript{43}

In response to school gardening, some believe it is only beneficial if there are multi-component interventions including nutrition education classes and home based components.\textsuperscript{26} This argument supports school gardens, but emphasizes the necessity of a stronger intervention needed to make an impact on reducing obesity or weight. Although there is no doubt that additional intervention such as, required educational courses would be beneficial, it is not conclusive that multi-component interventions are necessary for school gardens to generate change and improvements in childhood health behaviors.

Additionally, there are concerns related to the degree of feasibility for farm-to-cafeteria programs. In wake of these concerns there have been publications of guidebooks detailing how to implement farm-to-cafeteria programs from bottom-up. Critics suggest that these programs will be too difficult and too expensive to establish, but this argument is refuted through different approaches and methods to make these programs more manageable. Guidebooks include recommendations for starting the school service market, case studies of thriving farm-to-cafeteria


initiatives, suggested product preferences for the school food service buyer and more.\textsuperscript{44} Despite opposing arguments or concerns, a significant amount of evidence indicates that both school gardens and farm-to-cafeteria programs promote healthy behaviors through feasible means.

Although there are problems that face the expansion of school gardens and farm-to-cafeteria lunch programs, the benefit of improving childhood health cannot be overlooked or denied. The future health of the United States depends on challenging these barriers by instituting changes in the school food system. The demand for change is undeniable, but how to answer the call for action proves to be challenging. Developing best practices recommendations may help teachers; policy makers, parents, peers, and others overcome challenges that accompany school garden and farm-to-school lunch programs while also illustrating the valuable benefits.

\textbf{Methods}

The establishment of a systematic review and best practices will provide policy makers, schoolteachers, school administrators, parents, my peers, and more with centralized, practical information to improve the nutritional health of children through school gardens and farm-to-cafeteria lunch programs. This systematic review will aim to identify how childhood health can be improved through farm-to-cafeteria and school garden lunch programs. It will review the practices and affects of fourteen programs. After comparing, synthesizing, and analyzing the programs, a best practices study will be presented. The best practices will rank the most effective or superior program practices and least effective practices using a color-coded table. The quality of each program will be analyzed and provided in a legible, centralized template providing comprehensible and organized information that is easily accessible. My systematic review will

\textsuperscript{44} Tropp, Debra, and Surajudeen Olowolayemo. "How Local Farmers and School Food Service Buyers Are Building Alliances: Lessons Learned from the USDA Small Farm/School Meals Workshop, May 1, 2000." (2000).
aim to enhance the knowledge base of farm-to-cafeteria and school garden lunch programs and inform applicable audiences of practices for others to easily implement and follow.

I will first conduct a systematic review following the criteria listed below in the subsections titled, “Stage One”, “Stage Two”, and “Stage Three”. I will reveal my research in the Results section of this thesis. Tables will be provided outlining my selected inclusion and exclusion criteria. Each study will be categorized and applied to the criteria and tables accordingly. Limitations of my study will be considered later in the Discussion section. The results from the systematic review will then be applied to the development of best practices recommendations in the Conclusion section. Succeeding the completion of my systematic review, I will create a best practices recommendation according to the methods outlined above in the subsection titled Best Practices. My compilation of best practices for future school gardens and farm-to-cafeteria lunch programs will be detailed in both the Conclusion and Recommendations section of this thesis. The creation of the best practices will include data compiled from the systematic review ensuring an in depth analysis.

**Definition of a Systematic Review**

The presence of a systematic review, especially in areas of healthcare, is essential to provide decision makers and policy makers with synthesized and transparent information need to facilitate organizational or structural change.\(^{45}\) A systematic review differs from traditional literature or narrative reviews by offering a replicable scientific process.\(^{45}\) It is necessary to note that a systematic review attempts to minimize and reduce bias through its methodology by stipulating the procedure and conclusions.\(^{45}\) The ability for a systematic review to identify key scientific findings and contributions while avoiding bias is essential to build a case for

infrastructural change. The process of conducting a systematic review can be broken down into three main stages.

**Stage One**

Preparation for the systematic review, prior to conducting research, reporting, and drawing conclusions is critical. The inclusion and exclusion criteria of the review must be established to ensure consistency and reduction of bias. In this initial stage, it is recommended to organize a scoping study in order to evaluate the bearing and magnitude of literature on the selected subject area or topic. Gaining perspective of previous studies allows for cross-disciplinary and alternative research to be considered and accounted. Stage one can often include a brief overview of the subject area by providing theoretical, practical, historical information in addition to other material. Following an evaluation of literature, the researcher selects a definitive review question, which greatly impacts further structure of the systematic review. The review question connects the relevance of a study to the purpose of the review. Incorporating and building upon the definitive review question a review protocol is developed. The protocol allows the researcher to avoid objectivity through a detailed description of the intended review. Information on particular questions concentrated on in the review, the population or sample size of focus, search strategy, and criteria for inclusion and exclusion are delineated in the review protocol document. The inclusion and exclusion criteria are necessary to ensure the best quality of studies desired in the subject’s arena. All changes to the review protocol must be explicitly included in the review and supplemented with a rational for the alteration. Preparation research and outlining the goals and methods of the systematic review permits for a non-bias, thorough, and organized study.

**Stage Two**

Stage two consists of conducting the systematic review based on the detailed information and procedure provided in the review protocol and gathered in stage one. The identification of
keywords and search terms is the first step in conducting a review. These terms can be derived or influenced from literature previously reviewed in the scoping study or literature review. The search strategy is then defined and unambiguously recorded to ensure replication. Reviews may include all sources of information or can be limited to a singular framework including published journals, bibliographic databases, unpublished studies or other modes of material depending on the desired scope of coverage. Each study contained in the systematic review must meet all inclusion criteria and be exempt of all exclusion criteria. The number of sources selected for review and the number disregarded due to exclusion criteria must be documented at each stage of the review. Following this protocol while conducting a systematic review ensures the reduction of biases or errors. The processes of reviewing studies offer an extensive and synthesized platform for concise and effective conclusions and recommendations.

*Stage Three*

A successful systematic review encompasses a plethora of sources and data while synthesizing findings in a singular comprehensive document. Throughout the reporting and dissemination, in stage three, of a review’s findings the audience, context, and scope of research must carefully be considered. Reporting of data can be achieved by employing descriptive analysis and extraction forms using a set of categories. The intentions for the selection of each category must be justified to provide the clear implications of the review. A thematic analysis providing details including if a study’s results were concluded using an aggregative or interpretative approach, if any findings are considered known or established, a theme’s shared consensus or disagreement, and major budding themes and research questions can also be included in the reporting of findings. The reporting and dissemination of a review’s findings are considered to be the most powerful and influential because of its ability to influence decision makers and insight change.
**Definition of Best Practices**

A best practices document is a technique or methodology that presents extensive research and knowledge validating the successful methods to achieve a desired outcome. Best practice documents are typically common in areas such as, the education system, health, government administration, and project management. The phrase “best” should not be considered superlative. A best practices document is not based on perfection and does not only feature interventions that have been shown to contribute to positive outcomes. Results provided in a best practices document may be partial and can be associated with only one or more components of the practices being evaluated. Integrating components that are ineffective or that do not work is an essential element for the document. Illustrating unsuccessful interventions prevents the repetition of the same kinds of mistakes and allows other programs or projects to avoid failure.

Presenting knowledge of such actions widely accessible allows groups to use valuable time and resources in the most effective way. The documentation of a best practice encourages the continuation of improvements and the adaption of strategies through feedback, reflection, and analysis in hopes of creating a larger-scale, sustainable, and more effective intervention.\(^{46}\)

Particular actions must be taken to ensure a concise, legible, interesting and informative presentation of best practices. The application of the practice should address the main activities of implementation. Following the implementation of the practice, the results of the practice should be documented. This section includes what the solidified results of outputs and outcomes were based on a set of predetermined criteria. Identifying and selecting criteria for best practices requires judgment. Judgments must be based on prior analysis using a set of predetermined measures likely including, effectiveness, efficiency, and relevance, among other applicable

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conditions. After the results are presented, the lessons learned will explore what was successful about the practice, what facilitated the success, and what caused areas to be unsuccessful. Providing the discussion of each of these subjects presents a thorough and informative explanation of the practice. 

Documenting and disseminating best practices illustrates concrete, real opportunities to implement successful strategies and acquire knowledge. The goal of a best practice document is to detail the best methods allowing for the application of large-scale, sustainable, and more effective interventions while encouraging the development of improvements. Providing individuals, organizations, and populations with a best practices document incites change through the offering of practical interventions. Best practice documents are essential tools giving societies the opportunity to improve desired conditions.

**Systematic Review of School Gardens & Farm-to-Cafeteria Lunch Program Methods**

I will summarize the findings of studies that measure the effects of school gardens and farm-to-cafeteria lunch programs on childhood health through a systematic review collating and synthesizing data. Effect differences and sizes will be understood through a narrative synthesis. Searching for applicable data was conducted within two electronic databases: PubMed and PsycINFO. A broad range of childhood health, school garden, and farm-to-cafeteria lunch program keywords such as, school meals, grown food, and nutritional health, were used to search the databases. Table One of the Appendix shows a complete list of keywords used. Articles were included in the systematic review if inclusion criteria were met and articles were eliminated from the review if exclusion criteria were present. Inclusion criteria required articles to be: peer reviewed, a collection of data on measurements of farm-to-cafeteria lunch programs or school garden effects, an evaluation of nutritional, mental or psychological health, published after 1995, an English study conducted only within the United States, studying a sample size of at least
twenty primary or elementary grade level students in public schools, an empirical evaluation, a
quantitative study, and statically valuable having a p-value below 0.05. Articles were not
included if: published before 1995, books, conference proceedings, webpages, or in any other
format other than a peer review article, study was conducted outside of the United States or in a
language other than English, sample sizes were below twenty participants, participants were in
high school secondary education, or private schools, qualitative methods were used, and if data
was not statistically valuable with a p-value above 0.05. Inclusion and exclusion criteria can also
be found in Table Two and Three of the Appendix. The search process using keywords in search
strings to find articles in the databases is exemplified in the flowchart in Table Four of the
Appendix.

From all articles that met the review criteria, essential information was collected into a
standardized spreadsheet outlining the summary of findings from each article. The summary of
findings evaluates: the geographical region, size and age of participants, type of intervention,
research method, nutritional health outcomes, mental health outcomes (academic achievement,
psychological development, environmental exposure), relative effect, quality of the evidence,
and any other additional comments. This information is provided in Table Five of the Appendix.
The quality of evidence was determined using a grading scale ranging from high to low
measuring the quality and confidence in the research effects and magnitude of the effect. Grading begins at high and is downgraded by one level based on: biases in the study, limitations of design, inconsistency, imprecision, and indirectness. The quality of evidence grading scale is provided below.

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Data and effect differences measured in the summary of findings were then analyzed through a narrative synthesis in the Discussion. The narrative synthesis aims to develop a theory of how intervention of school gardens and farm-to-cafeteria lunch programs works, interpretation of study findings, preliminary synthesis organizing study findings and patterns among included studies, assessment of the strength of evidence, and an evaluation of the effectiveness of each intervention.47

**Best Practices of School Gardens & Farm-to-Cafeteria Lunch Program Methods**

Following the synthesis and narrative summary of the data received from my systematic review I will present the best practices to improve childhood health in the United States for the implementation of school gardens and farm-to-cafeteria lunch programs. The practices instigating the most change in childhood health will be prioritized. These methods with the best results will be indicated through a green shade. The practices yielding mediocre results showing some improvements, not as strong as the results found in the prioritized studies, will be signified by a yellow shade. Lastly, studies with little to no impact or change in childhood health will be denoted through a red shade. The colors green, yellow, and red illustrate the urgency and success
of each method. The best practices based on the studies found through my systematic review will
presented in my conclusion of this thesis and can be visually identified in Table Six of the
Appendix.

Results

The electronic databases returned a sizable number of articles (2,594), which indicates
the popular discussion of school meals and childhood health. Although many articles were
yielded, very view articles (14) were applicable to my research. Articles were rejected based on
too general and irrelevant titles and abstracts or the failure to meet my inclusion and exclusion
criteria. If articles had applicable abstracts or titles I would evaluate the entire article. The
fourteen articles were only selected after viewing the full-text. All of articles included in my
review produced significant statistical findings (p < .05) or through other statistical analysis. The
research methods used to evaluate effects of school gardens and farm-to-cafeteria lunch
programs were surveys (11), quasi-experimental (4), direct observations (3), interviews (2), and
baseline studies (2). Geographical settings of the studies included, Illinois, Michigan, Vermont,
Utah, Wisconsin (2), Florida, Alabama, Idaho, California (3), Pennsylvania, and New York. The
number of participants varied greatly. The smallest sample size was 34 and the largest sample
size was 4,588. I calculated the average participant size to be 817. In accordance with my
inclusion and exclusion criteria the participants’ ages only included elementary grade students.
The youngest age of the studies’ participants was five years old and the oldest age was thirteen
years old. The most frequent age group researched was forth and fifth graders that are nine and
ten year olds. There were six study intervention methods researched and some included multiple
methods of intervention. The interventions were: school gardens (4); school gardens and
nutrition education (5); farm-to-cafeteria lunch programs (1); school gardens, farm-to-cafeteria
lunch programs, and nutrition education (2); nutrition education incorporating physical activity, combined with farm-to-cafeteria lunches, and a farm field trip (1); and a single farm field trip and a single gardening experience (1). The conclusions of the intervention research were categorized into six health outcomes (Increase in Fruit and Vegetable Intake, Academic Knowledge Improvements, Social Skill Improvements, Improvements in Physical Activity, Nutrition Knowledge Improvements, Agriculture Improvements). Increases in fruit and vegetable intake was identified the most amount of times by nine articles, followed by nutrition knowledge improvements referenced in six articles and then social skill improvements recognized in three articles. One study noted that nutrition education programs were not enough to improve fruit and vegetable intake and that school gardens must be included for successful intervention.\textsuperscript{56} Academic knowledge improvements, physical activity improvements, and improvements in agriculture knowledge were documented the least amount of times, each outcome only appearing in two articles. Better math testing scores and overall classroom performance measured academic knowledge improvements in two studies.\textsuperscript{55-41} Enhanced agriculture knowledge was found through participants’ better understanding of how to grow vegetables.\textsuperscript{53} Social skills such as, improved confidence, self-efficacy, teamwork, sharing, and communication were also measured\textsuperscript{41-52}. These findings are especially important to consider because not only do school gardens and farm-to-cafeteria lunch programs have the ability to improve nutrition of children, according to the articles in this review, but also have the power to promote secondary benefits. The outcomes of each intervention were of significant statistical value ranging from $p < .0005$ to $p < .05$ or understood through other types of statistical analysis. The results of the studies show that school gardens and farm-to-cafeteria lunch programs have the ability to change children’s’ health.
Discussion

My review of fourteen articles revealed areas of success for improving childhood health outcomes through school gardens and farm-to-cafeteria lunch programs, but also exposed the need for further research. The articles represented only a few geographical areas of the Northeast, Southeast, and West regions of the United States. Representation of the Great Plains and Midwest was nonexistent, as illustrated in the figure below.

Geographical Locations of Article’s Research

![Geographical Locations of Article’s Research](image)

Figure 2.
Articles’ research location indicated by color highlight.

The implementation of nation-wide school gardens and farm-to-cafeteria lunch programs is dependent on more research in these areas. The outcomes measured in the articles demonstrate the need for policy encouraging or mandating these programs, but policy intervention will be hindered without the evidence that school garden and farm-to-cafeteria lunch programs can be implemented nation-wide, in all regions. In addition to the lack of research in the Midwest region, there is a deficiency of studies in rural settings compared to urban settings. Urban settings may be a more popular area of study because of easier access to garden facilities, better
transportation systems for delivering farm-fresh food, or simply because urban settings may be more convenient for researchers to access and common. Rural settings, similarly to the Midwest region of the United States, demand attention, especially because members of rural communities may be more susceptible to adverse nutritional health problems due to food deserts or poor access to health care infrastructures. Half of the articles included in my review did not indicate if research was completed in a rural or urban community, which is not ideal because the successful implementation of lunch programs cannot be made possible without understanding the affects in all settings and how a setting may influence outcomes. Articles that studied interventions in both rural and urban settings are ideal for school garden and farm-to-cafeteria lunch programs to better understand and compare differences in effect, if any. Figure 3 below illustrates that the majority of articles did not report the setting of the study and of those that did urban locations were more popular.

![Figure 3](image)

This figure illustrates the number of articles with a rural or urban research setting, both rural and urban research settings, and the number of articles that did not report if research setting was rural or urban.

In addition to the geographical region and community of the articles’ research, the number of participants in each article review varied greatly. The number of participants ranged
from 34 to 4,588 and each article had an average of 817 participants. The amount of participants in a study has a large effect on the quality of evidence, reliability, and ability to apply study findings to a larger population. Studies with a smaller sample size are susceptible to being less statistically significant if a p-value analysis is used. Understanding how sample size can affect the impact of outcomes is necessary in the evaluation of school gardens and farm-to-cafeteria lunch programs. While I was evaluating the purposefulness of each article I made sure to take into account the sample size. I had less confidence in smaller sample sizes because I was more reluctant to accept that the intervention would be applicable and successful in a larger population. This is especially important with the consideration of policies enforcing school garden and farm-to-cafeteria lunch programs. Despite these challenges, smaller sample sizes have the possible advantages of gaining more qualitative research providing more exploratory and detailed results. For example, one article was able to directly observe fruit and vegetable intake of children in the cafeteria because of the smaller sample size of 115. This allowed researchers to see if children were actually eating the fruits or vegetables, which was defined as eating more than half of the portion size. The advantage of direct observations and smaller sample sizes allows researchers to avoid self-reporting bias, but, again, a disadvantage is being able to relate these findings to a generalized population. The articles in my review present a wide range of sample sizes showcasing how effective school garden and farm-to-cafeteria lunch programs are. In Figure 4, below, the number of participants is illustrated showing the variability of sample size.
The number of participants researched in each article is outlined in this scatter plot graph. The large variability in participant size is visible.

Sample size is not the only significant feature of study participants. The demographic characteristic of participants has implications for both outcomes and reliability of the study. Nine and ten year olds were disproportionality represented in the fourteen articles, while those of younger ages had virtually no representation. The disproportionate amount of research on children aged nine and ten and the little of research on other age groups is represented in the figure below.

The average age of each article’s research participants is demonstrated in this figure showing which age group was researched more or less.

It is especially important to emphasize research on younger students because, as noted earlier, obese lifestyles occurring before kindergarten are predicted to continue throughout one’s
life course resulting in a greater need for immediate intervention through one of the first socialization experiences at schools.\textsuperscript{24} Additionally, intervention at younger ages has the ability to decrease the probability of obesity in adulthood. This knowledge of the trajectory of obesity illustrates the significance and need of research on younger aged students. Although there are greater benefits of intervention at younger ages, some studies reported challenges in obtaining survey answers from younger children who may not be capable of answering questions. One article on farm field trips studied children aged seven to eleven. Researchers were only able to survey the older children aged nine to eleven, because the students’ teachers thought the younger children, aged seven to eight would be unable to complete the survey due to a lack of competency.\textsuperscript{53} Acknowledgement of age groups in school garden and farm-to-cafeteria lunch programs is particularly important because the design of intervention may need to be tailored for each age or maturity to gain the most powerful results.

Another demographic feature of participants is socioeconomic status. Socioeconomic status measures the income and social or cultural characteristics of the studied participants. As discussed earlier, obesity disproportionately affects children of low socioeconomic status. Consequently, the majority of the articles reviewed studied participants of a lower socioeconomic status. The majority of articles that reported the socioeconomic status of participants may experience a research bias because if children of lower socioeconomic status are more susceptible to health problems, improvements may be easier to measure and outcomes may be more common. Although there is a greater need for programs in areas of lower socioeconomic status, participants of other statuses must be acknowledged as well. The socioeconomic status of the children that participated in the research presented in the articles reviewed is significant to discuss and acknowledge. Figure 6 shows the proportion of participants
of a low or non-low socioeconomic status and shows the lack of reporting of socioeconomic status.

The percentage of articles researching participants of a low or non-low socioeconomic status is shown. The percentage of articles that did not record socioeconomic status is also included.

Ethnicity of participants is another area of interest to understand the reliability and purposefulness of the articles’ outcomes. In addition to low socioeconomic status, minority ethnicities such as, African Americans, Hispanics, and American Indians, are another demographic characteristic disproportionately affected by obesity and adverse health effects. Interestingly, the majority of articles did not report ethnicity. This appears to be an area needing greater detail especially considering the increased appearance of health problems among ethnic minorities. Caucasians and non-Caucasians, or ethnic minorities, were equally represented in the articles reviewed. This is beneficial because it indicates that school garden and farm-to-cafeteria intervention does not have differential affects on varying ethnicities. As a result, these types of lunch intervention programs may be more likely to be accepted by policy makers because of the standardization of outcomes despite varying ethnicities of students. The ethnicity of participants and articles that failed report the ethnicity of participants is illustrated in the figure below.
The number of articles researching schools with predominantly Non-Caucasian students is shown. Additionally, the number of articles that did not report the most predominate ethnicity of student participants is included.

Study designs and method of intervention proved to be significant among the articles reviewed. Intervention is especially important because of its impact on outcomes. Research on the methods of intervention must be expanded as well. Studies focusing on school gardens dominated, resulting in the absence of more studies on farm-to-school interventions, which is demonstrated in Figure 8 below. Intervention methods among the reviewed articles greatly varied making it very difficult to evaluate which intervention is most effective. One study conducted in Utah used an intervention method that only lasted one day, whereas another study in Florida intervened for two years. Time spent in the garden, length of accompanying nutrition education lessons, intervention design and other factors varied. One intervention method must be established as the best method prior the installation of policies mandating school garden or farm-to-cafeteria lunch programs. This standardization is critical to the successful development and implementation of future programs.
The percentage of articles using school garden, or farm-to-cafeteria, or school garden and farm-to-cafeteria intervention methods is illustrated. Miscellaneous or other methods of intervention are also represented.

Research methods contribute to the articles’ validity and measured outcomes. All of the articles reviewed used quantitative measurements of outcomes. Quantitative measurements are beneficial because they provide comparable results, statistical analysis, reliability, and the ability to apply findings to larger and be replicated.\(^{48}\) These characteristics of quantitative studies are significant for the implementation of large-scale policies. Despite these advantages of quantitative measurements, there are some cons. Disadvantages include a lack of detail, richness, and depth of results and only receiving answers or information about the questions specifically asked in the study.\(^{48}\) The majority of data was collected by surveys, which is beneficial, but it would be more valuable to have many studies using several methods to avoid any bias or skew of data. Figure 9, below, shows the disproportionate employment of survey methods compared to other research methods used. Qualitative research methods are able to compensate for some of the challenges experienced in quantitative research. Qualitative methods are more exploratory

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and based on observational and interview methods. These methods allow for a more detailed, rich, and in-depth analysis resulting in the discovery of broad themes, theories, and patterns. Qualitative methods are beneficial by answering the questions that are not asked, but do encounter problems with multiple interpretations and can be limited to smaller sample sizes making it difficult to generalize findings.\textsuperscript{48} Quantitative and qualitative methods balance each other’s weaknesses and strengths. I suggest that future studies on school gardens and farm-to-cafeteria lunch programs employ both comparative research and ethnographic research or non-participant observation to understand the outcomes best. Quantitative comparative studies are able to contrast effects, while qualitative ethnographic research and non-participant observations provide an inside perspective of children’s true dietary habits. The coupling of these research methods suggests a successful study measuring different aspects of children’s health.

As discussed earlier, health is not only defined as the nonexistence of disease or illness, but also includes total physical, social, and mental well being. Each of these measurements of health should be evaluated in school garden and farm-to-cafeteria lunch programs. Only half of the articles in the articles I reviewed evaluated outcomes other than nutrition illustrating a need

![Research Methods of Articles](image)

**Figure 9.**
The methods of research for each article are shown illustrating the most and least common methods.

As discussed earlier, health is not only defined as the nonexistence of disease or illness, but also includes total physical, social, and mental well being. Each of these measurements of health should be evaluated in school garden and farm-to-cafeteria lunch programs. Only half of the articles in the articles I reviewed evaluated outcomes other than nutrition illustrating a need
for more focus on mental health or environmental health outcomes. Both methods of school gardens and farm-to-school interventions were shown to improve childhood nutrition health, but only a few studies measured other health outcomes. Greater attention on secondary outcomes in addition to nutritional outcomes has the ability to encourage decision makers to create policy regarding school gardens and farm-to-cafeteria lunch programs. Broadening our definitions of health to include outcomes such as, academic achievement and social skills may contribute to the generation of more research on outcomes other than nutrition. The main outcomes of the interventions from the articles are shown below in Figure 10. The majority of articles proved to show successful outcomes based on both the findings put forth by the articles and on my grading of the evidence and quality of articles’ findings. The successes illustrated in these articles have implications for policy, but it is crucial to recognize that no null findings were suggested. This indicates that there could be a publication bias because academic journals do not want to publish articles with null findings. Additionally, this presents a problem because we are not able to learn from the failures of school garden and farm-to-cafeteria lunch programs, which hinders improvements, and ultimately the health of children in the United States.

![Bar graph showing intervention outcomes of articles](image)

**Figure 10.**
The outcomes measured in the articles are demonstrated and compared in this bar graph.
Of course, strengthening the amount of research on school garden and farm-to-cafeteria lunch programs is necessitated, but my review identifies specific areas of content future studies must consider, including: younger participant age, geographical study setting in the Great Plains or Midwest, demographic characteristics of participants, diversified research methods besides surveys, expansion of intervention methods, particularly farm-to-school lunch programs, and the evaluation of several other health outcomes in addition to nutritional health. Extending research to other outcomes may also encourage more policy makers, schoolteachers, parents, and others to initiate school garden and farm-to-cafeteria lunch programs. Future studies should also consider researching participants of a wider age variety of. Policies in favor of school gardens and farm-to-cafeterias should be considered because of the findings presented in each article, but before any implementation further research must be completed to develop a standardized program.

Limitations

It is important to recognize the strengths and weakness of both the articles presented and of my own systematic review. I reviewed the quality of evidence for each article based on my confidence in the research and magnitude of effects. Eleven of the articles scored high because of a large sample size, length of study or other reputable factors. Two of the articles scored moderate due to lack of statistical analysis, only consideration of schoolteachers’ perspectives, and minimum length of study. The remaining study scored low because intervention methods only occurred one time, rather than over an extended period of time. Acknowledging these limitations is essential to encourage more research and to assure the accurate synthesis and representation of each article in my review. Consideration of differential effects is also required to properly evaluate these articles. Other environmental or external variables, such as parental income or genetics, could have affected outcomes. However, the average sample size (817) of the articles in my review reduces the probability of the occurrence of differential effects. More
than half of the data presented in the articles was self-reported, which has the potential to be subject to bias depending on prior knowledge and other factors. A final limitation of the studies represented in my review is the evaluation of mostly short-term health effects. The studies suggest significant improvements in participants’ immediate health, but none of the research identified effects on future health or the impact on obesity trajectories in later years or high school or beyond. Addressing these limitations acknowledges the potential of the studies’ weaknesses, but more importantly puts forth considerations for prospect research.

Limitations in my systematic review must also be identified to ensure an accurate and adequate representation of school garden and farm-to-cafeteria lunch programs. Exclusion criteria limited the complete evaluation of school garden and farm-to-cafeteria lunch programs. Prohibiting the inclusion of non-American studies, qualitative studies, studies with participants enrolled in private schools, studies with participants older than elementary school aged, among other exclusion criteria employed has resulted in the limitation and omission of other potentially significant studies. Restricting my search of studies to only two databases also impacts the results of my review. Additional limitations of my review include, a bias when evaluating the quality of evidence, the possibility of an inadequate search of literature, and the possibility of combining the results of well-designed studies with poorly designed studies. The potential of these shortcomings in my review are of great importance and consideration.

Conclusions

The children of the United States are suffering from a life-threatening health epidemic demanding the facilitation of infrastructural changes in the food system and built environment. Change in childhood health is dependent on multiple forces embedded in both the individual and the larger structure of society. The social ecological model is a theoretical framework used to
understand this interrelationship between the individual and environment. Connecting the individual to larger structural forces is crucial to improve childhood health. We cannot continue to consider the food system of the United States as something disconnected from our lives or as some distant entity. School gardens and farm-to-cafeteria lunch programs provide the means to link children with others, the local community, and larger structural food system of the United States. Larger structures affected by school garden and farm-to-cafeteria lunch programs include: agriculture, marketing and media, food industry, beverage industry, entertainment industry, cultural norms of food preferences, urbanization, and the natural environment. It is incredible to think that the implementation of school gardens and farm-to-cafeteria lunch programs have the ability to alter these large infrastructural systems, but the social ecological model outlines how effects can be transmitted from bottom-up or top-down. As previously mentioned, once greater research is conducted accounting for areas lacking information, public policies managing school lunches can have an impact not only on the individual child, but also their family or other interpersonal relationships, and the greater context of community members such as, local farmers, school staff members, and other community figures. The extended reach of school gardens and farm-to-cafeteria lunch programs is undeniable and has the ability to not only improve the health of children, but go beyond connection individuals to the natural environment, creating social support networks among community members, encourage improved land space use, and many other effects on the individual, interpersonal networks, community, and structural composition of the United States. The social ecological model embodies the many elements of change school gardens and farm-to-cafeteria lunch programs can insight after the refinement of future research and installation of policies. In the figure below the social ecological model is applied to childhood health in the framework of school garden and farm-to-cafeteria lunch
The Social Ecological Model and Table for Childhood Health

<table>
<thead>
<tr>
<th>Structural</th>
<th>Public Policy</th>
<th>Community</th>
<th>Interpersonal</th>
<th>Individual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>Public space policy</td>
<td>Schools</td>
<td>Teachers</td>
<td>Knowledge &amp; Information</td>
</tr>
<tr>
<td>Marketing &amp; Media</td>
<td>Public health policy</td>
<td>Workplace</td>
<td>Family</td>
<td>Attitudes of health &amp; environment</td>
</tr>
<tr>
<td>Food industry</td>
<td>School education policy</td>
<td>Recreational facilities</td>
<td>Peers</td>
<td>Self-efficacy</td>
</tr>
<tr>
<td>Beverage industry</td>
<td>School food policy</td>
<td>Built environment</td>
<td>Local farmers</td>
<td>Demographics</td>
</tr>
<tr>
<td>Entertainment industry</td>
<td>Free or subsidized lunch programs</td>
<td>Transportation system &amp; Land use</td>
<td>Social support, participation, &amp; integration</td>
<td>Physical activity</td>
</tr>
<tr>
<td>Cultural norms of food preferences</td>
<td></td>
<td>Restaurants &amp; food establishments</td>
<td>Community leaders &amp; figures</td>
<td>Dietary intake</td>
</tr>
<tr>
<td>Urbanization</td>
<td></td>
<td>Urban or Rural</td>
<td></td>
<td>Genetics</td>
</tr>
<tr>
<td>Natural environment</td>
<td></td>
<td>Organized sports &amp; other activities</td>
<td></td>
<td>Skills</td>
</tr>
</tbody>
</table>

Figure 11.

Above is the social ecological model and table for childhood health. This model shows the interrelationship between larger structural systems and the individual in the context of childhood health and school garden and farm-to-cafeteria lunch programs.

The presentation of this thesis and systematic review offers research on viable programs.49

interventions to improve childhood health through school garden and farm-to-cafeteria lunch programs. The discovery of these practical and effective solutions have the ability to not only restructure the nutritional health of children, but also improve academic achievement, social skills, and environmental attitudes and conditions, among additional contributions to the wellness of children and of the larger community of the United States. Beyond the affirmation of the successful outcomes of school garden and farm-to-cafeteria lunch programs, this thesis suggests specific areas of research to be expanded in hopes of providing policy-makers and other decision makers with the knowledge, research, and tools needed to provide school gardens and farm-to-cafeteria lunch programs. It is my hope that this thesis will promote my peers, and educators to insight change.

**Recommendations**

The benefits of school gardens and farm-to-cafeteria lunch programs must be taken advantage of, before it is too late for the children of the United States. Greater research addressing particular conditions and variables will contribute to the larger recognition of school garden and farm-to-cafeteria lunch programs as a viable means to improved childhood health and overall wellbeing. The absence of access to information or the overwhelming presentation of too much information may act as a potential barrier to the installation of school garden and farm-to-cafeteria lunch programs. Based on data collected from the fourteen studies included in my systematic review, I have developed a concise ranking of interventions and the accompanying expected outcomes. School garden were selected as the most effective intervention type because of higher valuable statistical significances and the ability to generate more outcomes beyond fruit and vegetable intake. Following school gardens, the combination of school gardens and nutritional education was selected and then school gardens, nutritional education, and farm-to-
cafeteria lunch programs. Lastly single field trips to farms and a single gardening experience was shown to be the least effective, especially because it does not generate a long-term effect. It is my suggestion for those interested in pursuing school garden and farm-to-cafeteria lunch programs to consider the methods of interventions outlined in my best practices table six, select the preferred intervention and outcomes, and further research the most suitable procedures for the children of the community. Be an advocate for the children of your community, don’t just wait for change—grow it!
Appendix

One
Hypothesized table of keywords used for search strings distinguishing keywords ultimately selected in bold.

<table>
<thead>
<tr>
<th>Reference for Study</th>
<th>Geographical Region</th>
<th>Number of Participants</th>
<th>Age of Participants</th>
<th>Research Method</th>
<th>Relative Effects</th>
<th>Nutrition Health Outcomes</th>
<th>Additional Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cafeteria</td>
<td>Community</td>
<td>Sample Sample</td>
<td>Child Care Children</td>
<td>Engagement Experience</td>
<td>Effects Improvement</td>
<td>Chronic Disease Fruit or Vegetable Intake</td>
<td>Attitudes Behavior</td>
</tr>
<tr>
<td>Farm</td>
<td>English</td>
<td>Size Size</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farm-to-school Program</td>
<td>Local Local</td>
<td>Study Participant Study Participant</td>
<td>Elementary Education</td>
<td>Intervention</td>
<td>Increased Health</td>
<td>Belonging</td>
<td></td>
</tr>
<tr>
<td>Farmer</td>
<td>Regional</td>
<td>Grade School Grade School</td>
<td></td>
<td>Practice Guidelines</td>
<td>Significant Diet</td>
<td>Connectedness to school</td>
<td></td>
</tr>
<tr>
<td>Food System</td>
<td>School School</td>
<td>Kids Kids</td>
<td></td>
<td>Statistical Food Choice</td>
<td>Food Choice Eco-literacy</td>
<td>Engage ment</td>
<td></td>
</tr>
<tr>
<td>Fresh Food Garden</td>
<td>United States United States</td>
<td>School-Aged School-Aged</td>
<td>Student Student</td>
<td>Quantitative</td>
<td>Fruit</td>
<td>Ecological Systems</td>
<td></td>
</tr>
<tr>
<td>Growing</td>
<td></td>
<td>Primary Education Primary Education</td>
<td></td>
<td>Eating Habit Healthy Eating</td>
<td>Fulfillment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grown Food Health Program</td>
<td></td>
<td>Nutrition</td>
<td>Nutrition</td>
<td>Grade Point Average</td>
<td>Interdisciplinary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local Food Education</td>
<td></td>
<td>Nutrition</td>
<td>Nutrition</td>
<td>Knowledge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local Food Program Public School</td>
<td></td>
<td>Diet Intake Diet Intake</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public School School</td>
<td></td>
<td>Vegetable Vegetable</td>
<td></td>
<td>Motivation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School Food School</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School Garden School Garden</td>
<td></td>
<td>Physical Activity Physical Activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School Lunch School Lunch</td>
<td></td>
<td>Physical Health Physical Health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School Meal School Meal</td>
<td></td>
<td>Political Lesson Political Lesson</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sustainability Sustainability</td>
<td></td>
<td>Relationship Relationship</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Two
Inclusion criteria table showing necessary characteristics for article selection.

<table>
<thead>
<tr>
<th>Reference for Study</th>
<th>Geographical Region</th>
<th>Number of Participants</th>
<th>Age of Participant</th>
<th>Type of Intervention</th>
<th>Research Method</th>
<th>Relative Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peer reviewed articles</td>
<td>English Studies</td>
<td>Sample size of participants must be greater than twenty participants</td>
<td>Primary or elementary grade level students</td>
<td>Must be empirical evaluation</td>
<td>Must be a quantitative study</td>
<td>Statistically valuable (p &lt; .05)</td>
</tr>
<tr>
<td>Collection of data on measure of farm-to-cafeteria or school garden lunch programs</td>
<td>Setting limited to American studies only conducted in United States</td>
<td>At least five years of age</td>
<td>Interventions must occur in public school setting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coverage of studies is limited to the following databases: PubMed, PsychINFO</td>
<td></td>
<td>Maximum thirteen years of age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluate some form of health or mental health or benefit of outdoor exposure</td>
<td>Published after 1995</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Three
Exclusion criteria table showing characteristics restricting article selection.

<table>
<thead>
<tr>
<th>Reference for Study</th>
<th>Geographical Region</th>
<th>Number of Participants</th>
<th>Age of Participants</th>
<th>Type of Intervention</th>
<th>Research Method</th>
<th>Relative Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sources other than peer reviewed articles</td>
<td>Studies conducted outside of the United States</td>
<td>Studies with a sample size less than 20 participants</td>
<td>Preschool or high school grade level students</td>
<td>Intervention in private school</td>
<td>Qualitative studies</td>
<td></td>
</tr>
<tr>
<td>Books, conference proceedings, webpages, government records etc.</td>
<td>Studies not conducted in English</td>
<td>No younger than five years of age</td>
<td></td>
<td>Intervention in setting other than public school</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Studies not retrieved from PubMed or PsychINFO</td>
<td></td>
<td></td>
<td>No older than thirteen years of age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Studies published before 1995</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Four**

Flowchart of systematic search and review process showing two examples of the identification and selection of articles using search engines and search strings and then showing the total returned search results and selected articles for review.

<table>
<thead>
<tr>
<th>Search Engine</th>
<th>Search Engine</th>
</tr>
</thead>
<tbody>
<tr>
<td>PsychInfo</td>
<td>PubMed</td>
</tr>
<tr>
<td>Search String or Phrase Using Keywords</td>
<td>Search String or Phrase Using Keywords</td>
</tr>
</tbody>
</table>
| School garden  | Agriculture OR garden* OR grown food OR school food* OR school lunch* OR school meal* OR sustainability OR cafeteria* OR farmer* OR fresh food*) AND (public school* OR elementary education OR grade school* OR primary education) AND (child OR children OR child care OR school-age OR student*) AND (nutrition OR health OR dietary intake OR eating habit* OR food choice OR health education OR healthy eating OR nutrition education OR nutritional behavior* OR physical activity OR physical health |}

<table>
<thead>
<tr>
<th>Number of Article Search Results</th>
<th>Number of Article Search Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>113</td>
<td>365</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Articles Included &amp; Excluded</th>
<th>Number of Articles Included &amp; Excluded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Included: 2</td>
<td>Included: 7</td>
</tr>
<tr>
<td>Excluded: 111</td>
<td>Excluded: 358</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Method of Intervention in Article: School Garden or Farm-to-Cafeteria</th>
<th>Method of Intervention in Article: School Garden or Farm-to-Cafeteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Garden: 1</td>
<td>School Garden: 5</td>
</tr>
<tr>
<td>Farm-to-Cafeteria: 2</td>
<td>Farm-to-Cafeteria: 2</td>
</tr>
</tbody>
</table>
Table of summary recording study characteristics, evaluation of evidence, employed search string and database used to retrieve article, and nutrition-related outcomes, academic-related outcomes, and social-related outcomes of school garden and farm-to-cafeteria lunch programs.

<table>
<thead>
<tr>
<th>Reference for Study</th>
<th>Farm-to-School and Nutrition Education: Positively Affecting Elementary and School-Aged&lt;sup&gt;50&lt;/sup&gt;</th>
<th>School Intervention Incorporates Farm-to-School Programs to Highlight Healthy Eating: A Report from Project Healthy Schools&lt;sup&gt;51&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographical Region of Study</td>
<td>Illinois</td>
<td>Michigan</td>
</tr>
<tr>
<td>Number of Participants</td>
<td>65</td>
<td>1,768</td>
</tr>
<tr>
<td>Age of Participants</td>
<td>8-9 Years Old</td>
<td>11-12 Years Old</td>
</tr>
<tr>
<td>Summary</td>
<td>Farm-to-School Program and Coordinated Approach to Child Health Care (CATCH). Two nutrition lessons, approximately thirty minutes long and one farm tour. At the farm field trip, students were introduced to the farmer, farm, animals, and learned where they get their school food. The study was four weeks long.</td>
<td>Farm-to-School Program, educational lessons and school gardens. Goals included eating fewer fast and fatty foods, eating more fruits and vegetables, and exercising at least 150 minutes per week.</td>
</tr>
<tr>
<td>Type of Intervention</td>
<td>Nutritional education incorporating physical activity, farm-to-school lunch program, and farm field trip</td>
<td>Farm-to-School Lunch Program, nutritional education, school gardens</td>
</tr>
<tr>
<td>Research Method</td>
<td>Quasi-experimental</td>
<td>Baseline Study</td>
</tr>
<tr>
<td>Outcomes Measured</td>
<td><strong>Nutritional Knowledge Improvements</strong> &lt;br&gt; Fiber is healthy (p &lt; .001) &lt;br&gt; Fruits/ Vegetables vitamins and minerals (p &lt; .05)</td>
<td><strong>Increase in Fruit and Vegetable Intake</strong> &lt;br&gt; Increased fruit or vegetable intake by at least one more (p &lt; .001)</td>
</tr>
<tr>
<td>Quality of the Evidence</td>
<td>☑️ ☑️ ☑️ &lt;br&gt; I would have liked to have a longer study</td>
<td>☑️ ☑️ ☑️ &lt;br&gt; I thought it was a very good sample size</td>
</tr>
<tr>
<td>Database and Search Phrase Used</td>
<td>PubMed &lt;br&gt; Search Phrase One</td>
<td>PubMed &lt;br&gt; Search Phrase Three</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Reference for Study</th>
<th>Social Cognitive Theory as a Framework for Considering Farm-to-School Programming&lt;sup&gt;52&lt;/sup&gt;</th>
<th>Farm Field Trips Provide Sensory Based Experiences with Fresh Local Produce&lt;sup&gt;53&lt;/sup&gt;</th>
<th>Farm to Elementary School Programming Increases Access to Fruits and Vegetables and Increases Their Consumption Among Those with Low Intake&lt;sup&gt;54&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographical Region of Study</td>
<td>Vermont</td>
<td>Utah</td>
<td>Wisconsin</td>
</tr>
<tr>
<td>Number of Participants</td>
<td>632</td>
<td>150</td>
<td>888</td>
</tr>
<tr>
<td>Age of Participants</td>
<td>8-11 Years Old</td>
<td>7-11 Years Old</td>
<td>8-11 Years Old</td>
</tr>
<tr>
<td>Summary</td>
<td>Personal experiences and characteristics with regard to fruits and vegetables with introduction of Farm-to-School Program. Shows that students cluster on basis of their personal characteristics and experiences. There are differences in student related behaviors between these clusters.</td>
<td>Measuring knowledge about growing vegetables and acceptance of eating vegetables through visit to farm and gardening.</td>
<td>Assess increasing students fruit and vegetable intake.</td>
</tr>
<tr>
<td>Type of Intervention</td>
<td>Measured effectiveness of social cognitive theory as framework for Farm-to-School Programs</td>
<td>Field trip to farm, gardening experience</td>
<td>Farm-to-School Program, school gardens, nutritional education</td>
</tr>
<tr>
<td>Research Method</td>
<td>Survey, Cluster Analysis</td>
<td>Survey</td>
<td>Quasi-experimental Baseline study Survey</td>
</tr>
</tbody>
</table>
| Outcomes Measured | **Increase in Fruit and Vegetable Intake**  
Farm-to-School Programming increases self-confidence, thus students were more likely to eat fruit and vegetables  
**Social Skill Improvements**  
More self-confidence, self-efficacy and confidence (high mean score) | **Nutritional Knowledge Improvements**  
Eating vegetables is healthy (p < .05)  
**Agriculture Knowledge Improvements**  
Growing vegetables (p < .05) | **Increase in Fruit and Vegetable Intake**  
Higher willingness to try fruits and vegetables (p < .001)  
**Agriculture Knowledge Improvements**  
Growing vegetables (p < .001)  
**Nutritional Knowledge Improvements**  
Eating fruits and vegetables is healthy (p < .001) |
| Quality of the Evidence | ☑️ ☑️ ☑️ | ☑️ ☑️ ☑️ Limited because only one-time intervention | ☑️ ☑️ ☑️ Measured different outcomes, large sample, and good statistical data |

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<sup>53</sup> Bevan, Stacy et al. “Farm Field Trips Provide Sensory-based Experiences with Fresh, Local Produce.” *Journal of Nutrition Education and Behavior* 44.3 (2012): 278 – 279.

<table>
<thead>
<tr>
<th>Reference for Study</th>
<th>Geographical Region of Study</th>
<th>Number of Participants</th>
<th>Age of Participants</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hollar, Danielle, et al. <em>&quot;Effect of a Two-Year Obesity Prevention Intervention on Percentile Changes in Body Mass Index and Academic Performance in Low-Income Elementary School Children&quot;</em></td>
<td>Florida</td>
<td>4,588</td>
<td>6-12 Years Old</td>
<td>Two-year long pilot project implementing Healthier Options for Public School Children Study (HOPS). Curricula component sought to teach nutrition, benefits of physical activity, improving health, and academic achievement. It was noted that fruit and vegetable gardens provided a fun and creative component to curricula.</td>
</tr>
<tr>
<td>Parmer, Sondra M. et al. <em>&quot;School Gardens: An Experiential Learning Approach for a Nutrition Education Program to Increase Fruit and Vegetable Knowledge, Performance, and Consumption Among Second-grade Students&quot;</em></td>
<td>Alabama</td>
<td>115</td>
<td>7-8 Years Old</td>
<td>There were six classes divided into three treatment groups over the course of twenty-eight weeks. Two classes received only nutritional education (NE), two classes received NE and gardening, and two classes served as control group.</td>
</tr>
<tr>
<td>McAleese, Jessica D., and Linda L. Rankin. <em>&quot;Garden-Based Nutrition Education Affects Fruit and Vegetable Consumption in Sixth-grade Adolescents&quot;</em></td>
<td>Idaho</td>
<td>99</td>
<td>10-13 Years Old</td>
<td>Twelve-week nutrition program and one group participated in school garden based activities. Measuring effects of garden based nutrition education on fruit and vegetable intake.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of Intervention</th>
<th>Research Method</th>
<th>Outcomes Measured</th>
<th>Quality of the Evidence</th>
<th>Database and Search Phrase Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>School gardens, nutritional education</td>
<td>Quasi-experimental</td>
<td>Academic Knowledge Improvements Higher math testing scores (p &lt; .001) Increase Fruit and Vegetable Intake BMI decreased (p &lt; .02)</td>
<td>Had big sample size, good analysis, and two-year long study</td>
<td>PubMed Search Phrase One</td>
</tr>
<tr>
<td>Nutrition education, school gardens</td>
<td>Survey</td>
<td>Nutritional Knowledge Improvements Nutrient-food association (p &lt; .001) Nutrient-job association knowledge significant (p &lt; .001) Fruit and vegetable identification (p &lt; .01) NE and gardening group was able to better identify some vegetables (p &lt; .001) Increase Fruit and Vegetable Intake More willing to try fruits and vegetables (p &lt; .005) Improved taste of fruits (p &lt; .001)</td>
<td>Large study and a lot of data analysis</td>
<td>PubMed Search Phrase One</td>
</tr>
<tr>
<td>Nutrition education, school gardens</td>
<td>Survey</td>
<td>Increase in Fruit and Vegetable Intake Fruit consumption increase (p &lt; .001) Vegetable consumption increase (p &lt; .001) Vitamin A intake increase (p &lt; .004) Vitamin C intake increase (p &lt; .004) Fiber intake increase (p &lt; .016)</td>
<td>Measured specific nutrition and fruit and vegetable outcomes</td>
<td>PubMed Search Phrase One</td>
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</tbody>
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<thead>
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<th></th>
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<tr>
<td>Geographical Region of Study</td>
<td>California</td>
<td>California</td>
<td>Pennsylvania</td>
</tr>
<tr>
<td>Number of Participants</td>
<td>593 (schoolteachers)</td>
<td>213</td>
<td>1,937</td>
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<tr>
<td>Age of Participants</td>
<td>9-10 Years Old</td>
<td>9-10 Years Old</td>
<td>9-10 Years Old</td>
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<tr>
<td>Summary</td>
<td>Assessed elementary school teachers’ attitudes and barriers of school gardens, the purpose and use of school gardens, and link between garden and nutrition.</td>
<td>One school with only nutrition education, one school with school garden-based nutrition and one school was a control. This intervention went for seventeen weeks.</td>
<td>Measuring attitudes and vegetable intake. There were sixty-eight control schools and seventy-two intervention schools.</td>
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<tr>
<td>Type of Intervention</td>
<td>School gardens</td>
<td>School gardens, nutrition education</td>
<td>School gardens</td>
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<tr>
<td>Research Method</td>
<td>Survey</td>
<td>Quasi-experimental</td>
<td>Survey</td>
</tr>
<tr>
<td>Outcomes Measured</td>
<td><strong>Academic Knowledge Improvements</strong> &lt;br&gt;Attitudes of effectiveness in academic performance (47%)</td>
<td><strong>Nutrition Knowledge Improvements</strong> &lt;br&gt;Maintained six month follow-up and gained more knowledge of nutrition (p &lt; .0005)</td>
<td><strong>Nutrition Knowledge Improvements</strong> &lt;br&gt;Vegetable preference (p &lt; .001)</td>
</tr>
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<td></td>
<td><strong>Social Skill Improvements</strong> &lt;br&gt;Teamwork, sharing, and communication (41%)</td>
<td><strong>Social Skill Improvements</strong> &lt;br&gt;Attitudes and self efficacy all improved (p &lt; .001)</td>
<td></td>
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<td></td>
<td><strong>Improvement in Physical Activity</strong> &lt;br&gt;Physical activity was promoted (47%)</td>
<td></td>
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<tr>
<td>Quality of the Evidence</td>
<td>☑☑☐☐</td>
<td>☑☑☐☐</td>
<td>☑☑☐☐</td>
</tr>
<tr>
<td></td>
<td>From schoolteacher perspective, not children and lacking some value because descriptive study</td>
<td>Large sample size and does six month follow-up</td>
<td>Very large sample size and provided further research on social skill improvements</td>
</tr>
<tr>
<td>Database and Search Phrase Used</td>
<td>PubMed &lt;br&gt;Search Phrase One</td>
<td>PubMed &lt;br&gt;Search Phrase Three</td>
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<tr>
<th>Reference for Study</th>
<th>LA Sprouts: A Garden-Based Nutrition Intervention Pilot Program Influences Motivation and Preferences for Fruits and Vegetables in Latino Youth&lt;sup&gt;60&lt;/sup&gt;</th>
<th>Examining the Effect of Gardening on Vegetable Consumption Among Youth in Kindergarten&lt;sup&gt;61&lt;/sup&gt;</th>
<th>School Gardens and Physical Activity: A Randomized Controlled Trial of Low-Income Elementary Schools&lt;sup&gt;62&lt;/sup&gt;</th>
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<td>California</td>
<td>Wisconsin</td>
<td>New York</td>
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<td>Number of Participants</td>
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<tr>
<td>Age of Participants</td>
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<td>5-11 Years Old</td>
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<tr>
<td>Summary</td>
<td>Intervention classes once a week for twelve weeks, forty-five minute interactive cooking and nutrition education lesson held within central outdoor space at the garden, and forty-five minute gardening lesson. This study was based on social cognitive theory measuring relationship between environment, person, and behavior.</td>
<td>Gardening interventions for ten weeks after the introduction of a salad bar in the cafeteria.</td>
<td>In twelve schools physical activity related to school gardens was measured.</td>
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<tr>
<td>Type of Intervention</td>
<td>School garden, nutrition education</td>
<td>School garden</td>
<td>School garden</td>
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<td>Research Method</td>
<td>Survey</td>
<td>Direct observation</td>
<td>Survey</td>
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<tr>
<td>Direct observation</td>
<td></td>
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<tr>
<td>Outcomes Measured</td>
<td><strong>Increase in Fruit and Vegetable Intake</strong>&lt;br&gt;Improved preference for vegetables&lt;br&gt;(p &lt; .06)&lt;br&gt;Reported vegetables from the garden were better tasting than from the store&lt;br&gt;(p value &lt; .05)</td>
<td><strong>Increase in Fruit and Vegetable Intake</strong>&lt;br&gt;Students were eating more fruits and vegetables at the salad bar (p &lt; .001)&lt;br&gt;Reported vegetables from the garden were better tasting than from the store (p value &lt; .05)</td>
<td><strong>Improvement in Physical Activity</strong>&lt;br&gt;Sedentary activity decreased (p &lt; .001)&lt;br&gt;More time spent in moderate and moderate to vigorous physical activity (p &lt; .44)</td>
</tr>
<tr>
<td>Quality of the Evidence</td>
<td>4 4 4 4 4 4</td>
<td>4 4 4 4 4 4</td>
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<tr>
<td>Participants went to garden weekly for three months, extensive research, and statistical data</td>
<td>Large study group state-wide and researched all elementary aged students</td>
<td>Used two types of data collection and provided further research on physical activity</td>
<td></td>
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</table>


Six
Best practices of intervention type suggested for future school lunch programs hierarchically ordered by color with green showing the most powerful and successful results, light yellow indicating moderate result, dark yellow representing slightly below moderate results, and red showing the least effective results.

<table>
<thead>
<tr>
<th>Intervention Type</th>
<th>Result</th>
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<tbody>
<tr>
<td>School Garden</td>
<td>Nutritional Knowledge Improvements</td>
</tr>
<tr>
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<td>Social Skill Improvements</td>
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<td>Increase in Fruit and Vegetable Intake</td>
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<tr>
<td></td>
<td>Improvement in Physical Activity</td>
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<tr>
<td>School Garden Nutritional Education</td>
<td>Academic Knowledge Improvements</td>
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<td>Nutritional Knowledge Improvements</td>
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<td>Increase in Fruit and Vegetable Intake</td>
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<tr>
<td>School Garden Nutritional Education Farm-to-Cafeteria</td>
<td>Nutritional Knowledge Improvements</td>
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<td>Single Field Trip to Farm</td>
<td>Nutritional Knowledge Improvements</td>
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<tr>
<td>Single Garden Experience</td>
<td>Agriculture Knowledge Improvements</td>
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Bibliography


