THESIS

THE EFFECT OF CSA MEMBERSHIP ON FRUIT AND VEGETABLE INTAKE

Submitted by:

Jessica L. Hedden

Department of Food Science and Human Nutrition

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Master's Committee:

Advisor: Garry Auld

Marisa Bunning
Frank Stonaker

ABSTRACT

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Objective: Increased fruit and vegetable intake has been associated with decreased BMI and disease rates (Ford & Mokdad, 2001; Lin & Morrison, 2002; Liu, 2000; Newby, et al., 2003; Riboli & Norat, 2003). Multiple barriers inhibit fruit and vegetable consumption, including the availability in the U.S. (Pollard, et al., 2002). Currently, there are many forms of alternative food networks (AFNs) such as farmers markets, community gardens and community supported agriculture (CSAs) providing local, seasonal produce to consumers, attempting to address availability and provide other outlets for fresh produce. This study examines the influences that CSA membership may have on fruit and vegetable intake.

Methods and Materials: Sixty-one participants were recruited from an average-sized CSA (<100 members; CSU), a large CSA (>2000 members; GFF), and non-CSA members (NON- as a control group). Three, 24-hour dietary recalls were collected by phone to estimate the produce components of each participant's diet over 6 months during the 2010 CSA season. Each diet was quantified based on the amount and variety of fruit, vegetables, total fruit and vegetables, and leafy greens.

Results: The groups were very similar in fruit and vegetable consumption at baseline. At the peak of CSA season (T_2), GFF participants were consuming more

vegetables (2.96 [0.26]) and more total fruits and vegetables (4.45 [0.40]) than NON participants (2.16 [0.29], $p<0.1$; 3.38 [0.45] $p<0.1$, respectively). Both CSU and GFF participants had an increased variety of vegetables over NON participants ($p<0.01$ and $p<0.001$, respectively) and participants from both CSAs had higher total variety ($p<0.01$) at Time 2.

Conclusions/Implications: From this study, variety was the major dietary difference in produce intake between both CSA groups and the control group. Demographic characteristics of participants were similar, indicating that the observed changes were likely a true relationship. A diet with increased variety of fruits and vegetables has been associated with increased health benefits, having the potential to reduce disease rates (Wirt & Collins, 2009). More studies need to be conducted examining larger study populations, the potential effect CSAs may have on low-income populations, and other forms of alternative food networks, such as farmers markets or community gardens.

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CHAPTER I

INTRODUCTION

With the rising rates of obesity in the U.S., there is a high level of importance placed on consuming a nutritious, balanced diet; fruit and vegetable consumption is one of the main focus points. Increased intake in this area is associated with a decrease in obesity and overweight individuals and is further capable of protecting against cancer, diabetes, and heart disease (Ford & Mokdad, 2001; Lin & Morrison, 2002; Liu et al., 2000; Newby et al., 2003; Riboli & Norat, 2003). The 2010 Dietary Guidelines recommends consuming 2 cups (or 4, ½ cup servings) of fruit and 2 ½ cups (or 5, ½ cup servings) of vegetables per day; encouraging a variety of dark green vegetables, orange vegetables, legumes, starchy vegetables, and other vegetables (USDA/HHS, 2005; USDA/HHS, 2010). Currently, about 11% of Americans are meeting the recommendation for both fruit and vegetables with 14% reporting no daily fruit and vegetable intake (Casagrande et al., 2007). Despite these recommendations, barriers prevent consumers from attaining these intake levels; e.g., a increased time for preparation and high cost (Pollard et al., 2002; Yeh et al., 2008). More so, the current supply of fruits and vegetables unable to meet dietary recommendations (Krebs-Smith et al., 2010). Further contributing to obesity and disease rates is the abundance of excess calories from fat, sugar, and refined carbohydrates found in American diets, particularly

as these are the least expensive to purchase (Drewnowski & Darmon, 2005; Putnam et al., 2002).

The aforementioned findings reveal glaring shortcomings in the current U.S. food system. There is an overabundance of inexpensive calories as demonstrated by the overwhelming rates of obesity and chronic disease, but there is an insufficient supply of healthful food. The increasingly globalized conventional food system has raised health and environmental questions to consumers about the state of the current foodshed. In response, alternative food networks (AFNs) have developed as avenues to bring local, sustainably-grown foods to consumers. The main goal of AFNs is to "create alternatives to the conventional, industrialized, global food system" and, in doing so, increase the supply of produce (Kloppenburg et al., 2000). Farmers markets, community gardens, and community supported agriculture (CSAs) are some of the outlets bringing local, seasonal produce to consumers. Currently, the impact that these outlets are having on the diets of consumers is unknown.

Much of the research pertaining to CSAs addresses prevalence, demographics of members, reasons for joining, members' and farmers' experiences, behaviors and attitudes of members, and CSA member retention using focus groups and surveys on a per-farm basis (Goland, 2002; Lang, 2005; Schnell, 2007). Quantitative measures on the impact of CSAs are largely undocumented in the literature, leaving many questions about how this may be affecting health status and fruit and vegetable intake levels of consumers. If CSA members are consuming more produce than the average individual, diet quality will improve while potentially decreasing overweight, obesity, and disease rates. This can be useful for farmers and farm managers in marketing the 'healthfulness

of a CSA membership' and increasing participation in communities nationwide. Though most CSA members have similar characteristics, CSA memberships could further be marketed to low-income populations who are known to have lower diet quality and higher disease rates (Drewnowski & Specter, 2004).

This study hypothesizes that diets of CSA members will include a higher and more varied intake of fruits and vegetables. This will be examined using participants from two CSA farms and non-CSA members within Larimer County, CO and following them throughout the 2010 CSA season. Dietary changes will be quantified and monitored using telephone 24-hour recalls. Dietary outcomes of amount and variety of fruit, vegetables, total fruit and vegetables, and leafy greens will be assessed.

CHAPTER II

LITERATURE REVIEW

Obesity and Chronic Disease – Associations with Fruit and Vegetable Intake

For over twenty years, overweight and obesity have been increasing in the United States. The second National Health and Nutrition Examination Survey (NHANES II), which included data on the health of a sample of the U.S. population from 1976-1980, estimated that 46% of men and women over the age of 20 were overweight; having a Body Mass Index (BMI) of greater than or equal to 25 (Flegal et al., 1998). From this percentage, 14.5% were categorized as obese; having a BMI of greater than or equal to 30 (Flegal, et al., 1998). In the most recent NHANES, from 2007-2008, these projections rose to 68% of Americans identified as overweight while over one-third of the population were obese (Flegal et al., 2010). Overweight and obesity have shown positive associations with numerous chronic diseases including Type 2 Diabetes Mellitus, hypertension, heart disease, certain cancers, asthma, and arthritis (Friedman & Fanning, 2004; Malnick & Knobler, 2006; Mokdad et al., 2003; Must et al., 1999). In addition to the health implications, overweight and obesity are associated with increased healthcare costs (Bhattacharya & Bundorf, 2009).

As the obesity epidemic has progressed, strategies to both reduce the prevalence of obesity and prevent further progression of the condition have been developed. While the etiology of obesity is a complex integration of genetic, environmental, and

socioeconomic factors, the basic principle behind weight loss is simple. There must either be a decrease of energy consumed and/or an increase in energy expended to create an energy deficit leading to weight loss. Rolls and Bell (2000) have promoted the idea of consuming foods of low energy density to promote weight loss, prevent weight gain, or maintain weight. By increasing the consumption of foods with high water content, such as fruits and vegetables, energy density decreases. This provides the volume of food to satisfy, but decreases the amount of calories consumed (Rolls & Bell, 2000). Using the aforementioned strategy, increasing fruit and vegetable consumption can be encouraged across the population of the United States to deter the progression of overweight and obesity (Rolls et al., 2004).

The inverse relationship between fruit and vegetable intake and body mass index (BMI) has been documented in several studies. To estimate lifestyle and dietary effects on BMI, the 1982 Cancer Prevention Study II conducted by the American Cancer Society collected information on the lifestyle and dietary habits of 79,236 men and women at baseline and then ten years later (Kahn et al., 1997). There was a significant decrease in BMI for individuals that consumed over 19 servings of vegetables a week (roughly 2.7 per day) for both men and women, while one of the strongest indicators of weight gain was meat consumption (Kahn, et al., 1997). Similarly, Lin and Morrison (2002) found an inverse association with fruit and vegetable intake and BMI in men and women in their examination of data from the Continuing Survey of Food Intakes by Individuals (CSFII) from 1994-1998. This relationship reversed when looking solely at consumption of white potatoes and was weaker in relation to children, but became stronger when isolating fruit intake. This may be because of the preparation methods of vegetables (i.e. adding high fat

condiments or oils in cooking) as opposed to fruits that are typically consumed raw (Lin & Morrison, 2002). In a prospective cohort study in Baltimore, 459 men and women were categorized into dietary patterns and BMI was monitored over time. A healthy diet pattern, characterized by high intakes of fruits, vegetables, reduced-fat dairy, and whole grains and low in red and processed meat, fast food, and soda, was associated with the most significant decrease in BMI (Newby, et al., 2003). Further, in 12 years of follow-up for the 74,063 participants of the Nurses' Health Study, women with the highest increase in fruit and vegetable intake were the least likely to become obese (He et al., 2004). While it should be noted that higher fruit and vegetable consumption can simply be associated with an overall healthier lifestyle, fruits and vegetables also contain fiber to increase satiety and have low energy density to mediate weight loss (He, et al., 2004). These outcomes of weight loss or prevention of weight gain are indicative of the beneficial effects associated with increased fruit and vegetable intake.

As weight reduction alone can reduce chronic disease incidence, so can an increase in fruit and vegetable consumption because of the presence of and interactions between vitamins, minerals, antioxidants, phytochemicals, and fiber (Liu, 2003). Several studies have shown an inverse relationship between whole fruit and vegetable consumption and risk of cardiovascular disease, diabetes in women, and certain cancers. In cardiovascular disease, increased fruit and vegetable intake has been related to decreased risk of coronary heart disease, ischemic stroke, and hypertension (Hu, 2003; John et al., 2002; Joshipura et al., 1999; Liu, et al., 2000). While some research suggests that the increase in fiber, magnesium, and antioxidants found in fruits and vegetables can be protective of diabetes, a large prospective cohort of 9,655 examined this relationship

and found the association only in women (Ford & Mokdad, 2001). In a review of the literature, Riboli and Norat (2003) identify that fruit and vegetable consumption has a protective role in stomach, esophageal, lung, and colorectal cancers while fruit consumption alone is protective of bladder cancer and vegetables alone are protective of breast cancer. This risk reduction is only statistically significant among cancers of the bladder and lung and is only seen in fruit consumption (Riboli & Norat, 2003). While the body of evidence cannot fully establish the protective effects of fruit and vegetable consumption in disease risk, there are numerous overall positive health benefits that serve as evidence to increase intake.

Fruit and Vegetable Recommendations, Supply, and Consumption

The United States Department of Agriculture (USDA) advocates diets high in fruits and vegetables (USDA/HHS, 2005; USDA/HHS, 2010). The 2010 Dietary Guidelines recommend consuming 2 cups (or 4, ½ cup servings) of fruit per day and 2 ½ cups (or 5, ½ cup servings) of vegetables per day, encouraging a variety of dark green vegetables, orange vegetables, legumes, starchy vegetables, and other vegetables (USDA/HHS, 2010). Similarly, the American Heart Association (AHA) recommends 4 to 5 servings of fruits and vegetables daily in accordance with the Dietary Approaches to Stop Hypertension (DASH) diet and Therapeutic Lifestyle Changes (TLC) diet, focusing on those products that are highly pigmented (Lichtenstein et al., 2006).

The National Fruit and Vegetable Program, sponsored by the National Cancer Institute (NCI), the American Diabetes Association, the American Dietetics Association, and the Centers for Disease Control and Prevention (CDC), among many others, is a "national partnership to increase consumption of fruits and vegetables by all Americans

by increasing consumer awareness of the health benefits of fruits and vegetables, increasing supply, and providing the necessary information and resources for consumers to change their current eating habits" (CDC, 2010). This initiative was started as 5 A Day for Better Health and, in 2007, was transitioned into Fruits and Veggies: More Matters to reflect the increase in recommendations following the 2005 Dietary Guidelines (CDC, 2010). Hopefully, this initiative, in conjunction with the Dietary Guidelines, will increase the fruits and vegetables being consumed, but, so far, the data has not shown any drastic changes in the supply or consumption in the U.S.

While the consumption of fruits and vegetables is highly encouraged, the supply of these in the United States has been insufficient. Using the Healthy Eating Index-2005 (HEI-2005) to examine the quality of the U.S. Food Supply from 1970 to 2007, Krebs-Smith et al. (2010) found that dark-green vegetables, orange vegetables, and legumes scored from 0.9 to 1.6 on a scale of 5 (a score of 5 indicates that the minimum amount is being supplied as per recommendations). Total vegetables, whole fruit, and total fruit scores for these years indicated that only half the recommended amount was available to the U.S. population with little change over the 37 years studied (Krebs-Smith, et al., 2010). The per capita supply of fruits and vegetables has increased over the past 30 years in the U.S., but still falls short of what is needed for each person to attain their USDA daily recommended quantities (USDA - Economic Research Service, 2010).

While the supply of fruits and vegetables to Americans has remained consistently low, so has consumption (Casagrande, et al., 2007; Serdula et al., 2004). Using data collected from the Behavioral Risk Factor Surveillance System (BRFSS), Serdula et al. (2004) examined fruit and vegetable consumption of Americans from 1994-2000. The

mean daily frequency of vegetables consumed by American men and women over this 6 year span remained stagnant at a mere 2 total vegetables. Total fruit and vegetable intake declined slightly, from consuming 3.44 each day in 1994 to 3.37 in 2000 (Serdula, et al., 2004). In comparing the data attained from NHANES III (1988-1994) to NHANES 1999-2002, Casagrande et al. (2007) identified that the proportion of Americans attaining their daily recommendation of vegetables has decreased from 35% to 32.5%, respectively. When fried potatoes were excluded from the criteria, the percentages dropped to 29.9% and 27.4% in 1988-1994 and 1999-2002, respectively. For total fruit and vegetable consumption, about 11% of study participants attained the USDA recommended amount, with no change between the two NHANES data sets. Fourteen percent reported no consumption of daily fruits and vegetables and about 25% of participants reported consuming no daily vegetables (Casagrande, et al., 2007).

While the national availability of fruits and vegetables certainly plays an important role in consumption, there are many other barriers and facilitators that may be influencing the current rates in the United States. In a review of factors that effect food choices, specifically fruits and vegetables, Pollard et al. (2002) saw that price was one of the major factors influencing food decisions, and the single most important factor for low-income consumers. While monetary cost, time constraints, and availability all influence what a consumer is able to buy, sensory appeal, familiarity, social interactions, personal ideology, media and advertising, and health will also influence what purchasing habits, thereby increasing the avenues that consumers can be reached to potentially increase their fruit and vegetable intake (Pollard, et al., 2002). The lowest amounts of fruit and vegetable consumption is observed among consumers with low education,

income levels, and social class status (Pollard, et al., 2002). Yeh et al. (2008) conducted focus groups with multi-ethnic populations in the U.S. and found that the barriers and facilitators to consuming fruits and vegetables were consistent across all ethnicities. The three main barriers identified were high cost, high spoilage rate, and lack of time paired with perceived extensive preparation time for fruits and vegetables. Enablers identified were knowledge about the positive health effects of fruits and vegetables, concern about children's health, and familiarity with taste and preparation style (Yeh, et al., 2008).

Typical American Diet and Food Purchasing Habits

In 2000, there was an estimated 3,900 calories available per person per day in the U.S. (Putnam, et al., 2002). Excess calories from fat, sugar, and refined carbohydrates are abundant in the food supply and are the least expensive to buy (Drewnowski & Darmon, 2005; Putnam, et al., 2002). "Added sugars and added fats, now accounting for close to 40% of daily energy intakes, help to keep down the cost of the American diet" (Drewnowski & Darmon, 2005). Processed foods dominate the U.S. market and are dependent on "artificial colors, flavors, stabilizers, emulsifiers, sweeteners, and preservatives for their appeal" (Kloppenburg et al., 1996). This inexpensive diet of low quality is one of the contributing factors to the increased prevalence of overweight and obesity observed in the population (Baum Ii & Ruhm, 2009; Drewnowski & Specter, 2004).

The average American currently spends less than ten percent of their income on food, but among low income consumers, this percentage can increase to 20-25% (Clauson, 2008). While taste is the first predictor of food purchasing patterns for most Americans, cost replaces it by a significant margin when dealing solely with low income

populations (Glanz et al., 1998; Pollard, et al., 2002). As a result, low income populations are the least likely to purchase fresh fruits and vegetables leading to greater health disparities in this population (Fiscella & Williams, 2004). Low income populations are much more likely to suffer from overweight and obesity also, which is the focus of many community nutrition interventions specifically dealing with fruit and vegetable consumption (Drewnowski & Specter, 2004).

Food Systems

The aforementioned findings reveal glaring shortcomings in the current U.S. food system. There is an overabundance of inexpensive calories as demonstrated by the overwhelming rates of obesity and chronic disease, but there is an insufficient supply of healthful food, with an even greater inability to access fresh fruits and vegetables by low-income populations. In an effort to determine the cause of this paradox, an examination of the state and sourcing of the U.S. foodshed is necessary. The term foodshed was first coined in 1929 to describe the variety of avenues by which food enters into a particular place, being applicable to any geographical region whether it be a community, state, or country (Hedden, 1929). Today, this term is being revitalized to have consumers envision the state of our foodshed in terms of where food is grown and transported for consumption as well as its social and cultural context (Feenstra, 1997; Kloppenburg, et al., 1996).

Within the U.S., food products travel an average of 1200-1500 miles from farm to its destination (Pirog & Benjamin, 2003; Weber & Matthews, 2008). However, with the increase in international production of foods, a study out of the Waterloo Region of Ontario, Canada estimated this to be about 2800 miles (4497 km) and growing (Xuereb,

2005). This distance affects the social and cultural aspect of our foodshed as events occurring outside of our immediate geographic region impact the quality and cost of the food available in the U.S.

Consumer concern over where and how food is being produced is creating new outlets for farmers committed to raising food sustainably and distributing it to their immediate communities to bolster local economies. In the literature and among consumers, there is ambiguity in terms used to describe the intertwining factors characterizing the current food system and the trends that are occurring. This section will outline these often confusing terms and trace the trends currently opposing conventional agriculture.

Conventional Agriculture

Conventional agriculture refers simply to the mainstream way of producing food. In recent decades, these agricultural production methods have evolved into a global-based system with increased reliance on synthetic petroleum-based fertilizers and pesticides, large-scale mechanization, non-renewable fossil fuels, and increasingly large farm size (Beus & Dunlap, 1990; Murdoch et al., 2000; Youngberg, 1984). The National Research Council (2010) defines conventional crop production as making:

> "use of synthetic pesticides and herbicides, and supplements nutrients generated on the farm (manure) with synthetic fertilizer to maintain soil fertility. Fields are more frequently planted in few rotations of marketable crops than left fallow or planted with cover crops. Conventional corn, soybean, and cotton farms are increasingly planted with seeds that are genetically engineered to facilitate weed control or to reduce pest losses (and pesticide use)."

In conventional agriculture, comparative advantage is employed, where each country is responsible for a few foods to export and imports the crops that it cannot produce as well (La Trobe & Acott, 2000). Local producers in the U.S. who are limited to seasonal

production are replaced by producers who can supply a consistent, year-round crop (Kloppenburg, et al., 1996). In 2009, the US had a $5.7 billion trade deficit of fresh and processed fruits and vegetables as the country acquired these products predominantly from Canada, Mexico, Chile, and China, among many others, where production can happen more efficiently (Johnson, 2010). "Analysts see globalization in the food sector as derived from agencies which aim to promote new interlinkages between the principal actors, spread new uses and forms of technology, and establish new commodity forms in mass markets" (Murdoch, et al., 2000). In response to the growing number of people in the world and, therefore, the increased demand for food, this type of response is to be expected.

However, while the development of conventional agriculture may be strategic in producing enough food for the world's growing population, there have been many negative side effects of this modern, industrialized agriculture. In order to accommodate the higher demand for food production and increase profits from farming, farm size and mechanization has increased while the number of workers on the land has decreased (Beus & Dunlap, 1990). In 1900, 38% of the labor force considered themselves farmers and the average farm size was 147 acres. In 1990, only 2.6% of the workforce considered themselves farmers and in 1998, the average farm size was 435 acres (USDA - Economic Research Service, 2000).

Continued efforts are made to reduce the importance and constraints of nature in the food production process (Murdoch, et al., 2000), leading to the depletion and erosion of soils, decreased biodiversity, and contamination of groundwater (National Research Council, 1989). Nitrogen and phosphorous fertilizers, used to replenish soil nutrients

before and after cropping, totaled 121.3 million metric tons in 2000 (Tilman et al., 2001). Use of pesticides, including herbicides and insecticides, is one of the most common methods of controlling weeds and insects, which peaked at 579 million pounds of active ingredient (a.i.) in 1997 but has since declined to 495 million pounds a.i. in 2004 due to the development of genetically modified seeds and new regulations on pesticide usage (Osteen & Livingston, 2006). Still, new pesticides must continually be developed as pests acquire resistance over time (La Trobe & Acott, 2000).

Biodiversity is being reduced as monocropping becomes more prevalent. In monocropping, single varieties of each crop are planted, leaving it more susceptible to diseases and pests, increasing the need for pesticides (Horrigan et al., 2002). Biodiversity in nature prohibits widespread damage by producing similar fruits with slightly different characteristics that can ward off ever-changing threats. By minimizing biodiversity, crops are threatened worldwide as diseases and pests become resistant to products faster than they can be developed (Horrigan, et al., 2002).

Nonpoint pollution of surface waters is also a major problem when the excess nutrients in fertilizers are applied to the soil and then leached into nearby water sources (Carpenter et al., 1998; Tilman et al., 2002). Soil degradation and erosion is increasing with intensity of agricultural practices involving improper crop rotation, nutrient fortification, and water management (Tilman, et al., 2002). Though defendants of this system support its necessity as a way to feed the ever-growing global population, the inputs needed to maintain these operations are expensive and quickly being depleted.

Sustainable/Alternative Agriculture

Sustainable agriculture "entails a form of resistance to and mobilization against the socially and environmentally destructive conventional agriculture" (Hinrichs, 2000). This is carried out through the development of more environmentally sound food production methods. Tilman et al. (2002) define sustainable agriculture as "practices that meet current and future societal needs for food and fibre, for ecosystem services, and for healthy lives, and that do so by maximizing the net benefit to society when all costs and benefits of the practices are considered." The ideals behind sustainable agriculture are just as much a mindset as they are the actions practiced in the field.

In the Food, Agriculture, Conservation, and Trade Act of 1990, sustainable agriculture is defined as:

> "an integrated system of plant and animal production practices having a site-specific application that will, over the long term: satisfy human food and fiber needs; enhance environmental quality and the natural resource base upon which the agricultural economy depends; make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls; sustain the economic viability of farm operations; and enhance the quality of life for farmers and society as a whole" (U.S. Congress, 1990).

Because of the progression of sustainable agriculture over the last 20 years, a single, dichotomous definition for this in comparison with conventional agriculture cannot be distinguished (National Research Council, 2010). Sustainable farming practices can incorporate any or all components of biodynamic, organic, low-input, conservation agriculture, and integrated farming systems (National Research Council, 2010). All of these look to resources other than synthetic fertilizers and pesticides to maintain the vitality of food sources and the environment.

Not only is the physical form of sustainable agriculture drastically different than conventional agriculture, but so also the mindset. Some authors argue that this is one of the main impacts that sustainable agriculture hopes to achieve – social responsibility for quality of life for the farmers, maintaining the integrity of the soil, and producing quality food for consumers (Gershuny & Forster, 1992; National Research Council, 2010).

In a conference of consumers, producers, and activists in the upper Midwest, Kloppenburg et al. (2000) attempted to define the attributes of a sustainable food system. In comparing their results with the Wisconsin Foodshed Research Project, the seven characteristics of sustainable agriculture that remained consistent were that it is environmentally sustainable, proximate (or local), economically sustaining, participatory, just, healthful, and diverse. The other characteristics identified by conference participants were that sustainable agriculture is communicative or knowledgeable, sustainably regulated, sacred, culturally nourishing, seasonal, contains value-oriented economics, and relational (Kloppenburg, et al., 2000). Regardless of the specific definition of sustainable agriculture, the basic underlying principles of the ideology are consistent across people-groups and the literature; it is a way to provide a food production system that is more environmentally aware and will continue to produce now and for generations to come without depleting the earth's natural resources (DuPuis & Goodman, 2005; Follett, 2009; Kloppenburg, et al., 1996; Youngberg, 1984) .

Alternative Food Networks

Alternative food networks (AFNs) are the avenues by which the products of sustainable agriculture reach consumers and embody many of the same core values as sustainable agriculture. The main goal of AFNs is to "create alternatives to the

conventional, industrialized, global food system" (Kloppenburg, et al., 2000) but the way in which it is constructed differs by communities and their individual needs.

Some of the core values of AFNs are to create an environment of good nutrition as an alternative to highly processed foods, reduce petroleum-based inputs through a focus on local and in-season foods, revitalize traditional food preparation techniques, maintain environmental biodiversity, and reduce the environmental impact of agriculture (Gregory & Gregory, 2010). Similar to sustainable agriculture, AFNs lack a concrete definition and their priorities may differ, but all are rooted in the values of sustainable food production and distribution (Youngberg, 1984).

More recently, this trend has been propagated with the release of several books such as *Fast Food Nation* (Schlosser, 2002), *Animal, Vegetable, Miracle* (Kingsolver et al., 2007), *Slow Food Nation* (Petrini, 2007), and *Omnivore's Dilemma* (Pollan, 2006) and movies such as *Food, Inc* (Kenner, 2008). These have increased the popularity of the local and organic food movement, indicating that consumers are becoming more concerned with the welfare of their food system and the impact it is having on health, economies, and environment (Kloppenburg, et al., 1996). Regardless of definition, alternative food systems attempt to bring the consumer face to face with the producer, for example, through farmers markets, community supported agriculture (CSAs), and community gardens.

Local Foods

Consuming food closer to home "reduce(s) energy consumption, enhance(s) local awareness and control of food production, and make(s) the food supply less vulnerable to disruption" (Beus & Dunlap, 1990). Statewide initiatives promoting local foods such as

"Jersey Fresh," "Arizona Grown," "Colorado Proud," and "AgriMissouri" have had wide ranges of success in increasing sales of local food products (Brown, 2003; Govindasamy et al., 1998; Loureiro & Hine, 2002; Patterson et al., 1999). Local food initiatives aim to support local farmers, businesses, and economies by promoting the purchases of foods grown and processed within close geographical proximity. The definition of close proximity, however, is ambiguous. Typically, consumers' definitions of "local" is more a reflection of geographic location rather than definite state boundaries, often impacting the success of state-based initiatives (Brown, 2003; Wilkins et al., 2002). Using four focus groups from Madison, WI, Zepeda and Leviten-Reid (2004) identified that although consumers had varying views of what "local" means, they all had positive attitudes towards shopping locally. As seen in this study and another conducted by Lockeretz (1986), this enthusiasm did not translate directly into purchasing unless the consumers perceived direct environmental, economic, community, and health benefits. These beliefs were more prevalent among shoppers that were already exploring alternative food systems than shoppers that used predominantly conventional outlets (Lockeretz, 1986; Zepeda & Leviten-Reid, 2004). While most consumers are able to identify local and seasonal foods, especially fruits and vegetables, those shopping at conventional outlets identified convenience as one of the major factors driving food purchasing choices, therefore decreasing the probability of purchasing local foods (Lockeretz, 1986; Wilkins, et al., 2002).

Taking a sample of shoppers nationwide, Zepeda (2009) found that there was no difference in age, education, or race of people that prefer local shopping venues, specifically farmers markets, than those who did not shop locally. Despite low-income

consumers being underrepresented in her sample, shoppers at farmers markets were still most likely to be in the second lowest quintile of income ($15,000-$29,999) (Zepeda, 2009).

One of the widely held beliefs behind purchasing food directly from local farmers and producers is that consumers are able to create and sustain their local economy. As a result of this benefit to local economies, there has been a significant increase in direct farmer to consumer sales nationwide in recent years (Timmons & Wang, 2010). This is an indication that local markets are becoming more socially embedded than traditional markets. Social embeddedness refers to the extent to which something, in this case it is a local food system, becomes an integral part of a community for the relationship that is established. Critical aspects of local food systems are in the varying degrees of social embeddedness (DuPuis & Goodman, 2005; Hinrichs, 2000; Morgan et al., 2006; Murdoch, et al., 2000). In examining farms in Minnesota, one of the key features the farmers focused on establishing was an embeddedness of sustenance – that the people who purchase and consume the food would know the farmers that grew the food and the relationship would be beneficial both socially, for the consumers, and economically, for the farmers (Cone & Myhre, 2000).

Morgan, et al. (2006) contest that in describing local foods as specifically socially-embedded, it places the concept on an ideological scale instead of a practical one. This can be detrimental to the local foods movement as action is required, not just philosophy. However, by socially embedding local foods, a deep relationship is created between consumers, who desire the production of local foods and the food producers,

who are in need of financial support. This can establish long lasting markets within communities and can have economical as well as environmental and health implications.

Alternative Food Network Venues

Farmers Markets

Farmers selling their produce directly to local consumers is not a new concept. As early as the 1940s, farmers markets were documented as a method of selling produce cheaply without the produce broker as a middle man, most likely in response to the economic downturn of the Great Depression (Brown, 2001). While there was expected to be a post-war boom of these local markets in the United States, numbers remained stagnant with the increase in industrialization and convenience in the food supply. Consumer demand for local, seasonal produce was lost in the expansion of the highway (Brown, 2001). The 1970s were the next time period that farmers markets surged in popularity. Brown (2001) asserts that this period of farmers market growth was a result of "radical political action, overt and covert racism, individual initiative, a crackpot's fear of chemicals, and a deadly hurricane." This time, the national government came on board. In 1975, the US House of Representatives, in House Resolution 2458, defined farmers markets as "any marketplace where at least ten farmers congregate for the purpose of selling their agricultural commodities directly to consumers in a manner designed to lower the cost of food for the consumers while providing an increased income to the farmers" (U.S. House of Representatives, 1975). This is much different from the markets observed today, as the number of farmers may be fewer than ten and the prices are often more expensive than the supermarket (Brown, 2001). Farmers markets have come to include several different definitions, but the important factor is that producers sell

directly to consumers without a middleman. For food, primarily fresh produce, this involves mostly seasonal, local produce, hence, an avenue for alternative food networks.

Depending on the specific farmers market, wholesale items may be permitted, while others may restrict vendors to be producers, or only local producers. Because of this variation in type of farmers market, accounting for the total number of markets has been difficult. One of the first analyses of farmers markets that sparked new interest in the agricultural and academic sectors was released in the early 1970s (Pyle, 1971). Soon after, the Public Market Collaborative, a sector of the Public Market Project, the Public Market Partners, and Purdue University all estimated the number of farmers markets. The few documentations indicate that there were 342 markets in 1970, 1,225 markets in 1980, 1,696 in 1986, and 1,890 in 1989 (Brown, 2001). Beginning in 1994, the USDA began tracking the presence of farmers markets in the United States, recording them in the National Directory of Farmers Markets. This has not only allowed consumers to search for the nearest location and enabled farmers to coordinate with other local farms, but also tracked the growth of farmers markets. In 1994, there were reported to be 1,755 farmers markets. As of 2010, the number has grown to 6,132 (USDA - Agricultural Marketing Services, 2010).

Community Gardens

Community gardens are publicly owned, or privately owned for public use, spaces designed to meet the individual needs of a community (Ferris et al., 2001; Guthman et al., 2006). The concept was derived from the victory gardens promoted during World War II (Lackey, 1998). The purpose of the garden can be for health, food security, teaching, reclaiming the land, or maintaining cultural habits of immigrants in the United States

(Ferris, et al., 2001; Twiss et al., 2003). Many community gardens have been developed in urban areas, i.e., urban gardens, taking advantage of often-abandoned lots and providing a fresh produce source as well as a green landscape in the urban environment. School gardens are community gardens in a school-based setting, providing education to students on origins and production and encouraging produce consumption in and out of school.

The American Community Garden Association (ACGA) is a nonprofit organization started as a resource to communities on how to start and maintain a garden over multiple seasons. In addition, it publishes research and articles to bring together professionals in the field. As of 1996, they reported over 6,000 community gardens nationwide (ACGA, 2010). However, it can be assumed that there are more, as the survey was distributed to only 40 cities. The majority of these are found in neighborhoods and public housing and serve to save consumers money on food, provide a steady source of fruits and vegetables, and bring communities together (ACGA, 2010). In the 15 years since this survey, it can be assumed that the number of these gardens has grown nationwide as have other alternative food networks.

Community Supported Agriculture (CSA)

The framework for Community Supported Agriculture (referred to as CSAs) originated in Switzerland and Japan in the 1960s but wasn't introduced into the United States until the mid-1980s (DeMuth, 1993). The original intent was to create a venue where safe food could be sold to a guaranteed market with consumers and farmers collaborating in economic partnerships (DeMuth, 1993). Jan Vander Tuin and Robin Van En started the first CSA farm in the United States in 1985 in the Berkshire Mountains of

Massachusetts (Cone & Myhre, 2000; Lang, 2005). In 5 years, the number of CSAs had grown to 50 and, in 2009, localharvest.org, an online database of local foods, reported over 850 CSAs ("Community Supported Agriculture," 2010). This growth is attributed largely to recent concerns about food safety, environmental degradation, and globalization (Lang, 2005). CSAs make personal connections between consumers and farmers and raise awareness about food (Schnell, 2007). It is a partnership between farmers and consumers in which the consumers are assured of where and how their food was produced and farmers are guaranteed an income without dealing with a fruit or vegetable broker (Lang, 2005). In accordance with alternative food networks, CSAs encourage the restructuring of the current global food system and encourage ecological sustainability to reestablish local agricultural economics (Henderson & Van En, 1999). Most CSAs are organic or biodynamic while a few are transitioning to organic or low-chemical use (Henderson & Van En, 1999). The concept of embeddedness in the local food system is demonstrated clearly through the implementation of CSAs by establishing the interdependence between the food supply and local economies (Cone & Myhre, 2000).

Community Supported Agriculture is also known as “subscription farming” and the terms are often used interchangeably. The concept behind CSAs is that the consumer purchases a ‘share’ in the farm, providing money up-front before the growing season has begun. The farmer uses this investment for startup costs for the growing season knowing that he or she has a market for the farm’s produce. Then, during each week of the growing season, the CSA member receives a ‘share’ of produce from the farm (Lass et al., 2003). This share may come in the form of a box, bag, or members might have to pick

this up from a farm-stand-like setup or even go into the field to pick their own produce. Depending on the size of the share, the member is given a certain amount and variety of produce, forcing them to consume, store, and share what they are given and then compost, share, or discard what is left. While the most basic CSA will offer a vegetable share to consumers, some offer fruit, egg, meat and poultry, flower, herb, or other supplementary shares, usually for an additional cost (DeMuth, 1993; Lang, 2010). Also, some farms offer working shares, which allow consumers to spend time working on the farm in exchange for a share or a discounted share price (Lang, 2005). For many CSA members, the produce they are given is not necessarily what they would have purchased in the grocery store, therefore turning the CSA membership into a learning experience (Brown & Miller, 2008).

There is a shared-risk mentality behind CSA membership in that if there are optimal growing conditions and an abundant harvest, the consumer will receive more produce for their initial investment. However, if the harvest is suboptimal, the consumer must accept the risks involved with farming and may not receive as much produce that season (Schnell, 2007).

Much of the current research pertaining to CSAs is concerned with prevalence, demographics, reasons for joining, members' and farmers' experiences, behaviors and attitudes of members, and satisfaction with the CSA farm that brings participants back year after year. The majority of research has been done with focus groups and surveys on a per-farm basis because CSA design varies greatly across the country in size, growing methods, products offered, delivery methods, and member involvement (Lang, 2010; Russell & Zepeda, 2008).

Why Join?

Though there are several reasons that prompt consumers to join CSAs, these appear to be consistent across the country. In light of the globalized food system, people desire fresh, local, and organic produce as well as wanting to support local farmers and farms (Cone & Myhre, 2000; Goland, 2002; Oberholtzer & Project, 2004; Perez et al., 2003). Support of sustainably grown food was another reason identified (Cone & Myhre, 2000). These are key insights that can help farmers understand why people initially choose to participate and how to retain them season after season. Much of the literature documents the importance of variety and quality and how much these correlate with member satisfaction. On the other hand, the food mix provided is sometimes what causes consumers to discontinue their CSA membership as they aren't prepared for the wide variety supplied (Perez, et al., 2003).

CSA Member Demographics

Along with reasons for joining, the demographics of CSA members across the country are surprisingly similar. Oberholtzer and Project (2004) found that the majority of CSA members were women, between 30 and 60, highly educated, with an income of more than $25,000/year. Lang (2005), in an assessment of 5 mid-Atlantic CSAs in 2000, found that most participants were female, between the ages of 30 and 50, and had an average income between $55,001 and $75,000. He conducted another survey of CSA members in 2000 in a larger CSA in Washington, D.C. and found consistent results – a majority of members were female, white, highly educated, making over $75,000 a year, and were between 30 and 55 years old (Lang, 2010). The high proportion of female members across these studies may be due solely to the fact that they are the gatekeepers

for families' eating habits and are representative of their families in the surveys. Still, these results are consistent with other studies (Cone & Myhre, 2000; Goland, 2002; Russell & Zepeda, 2008). Schnell identified a positive correlation in annual income and number of CSAs in the area as well as in percentage of white-collar workers and number of CSAs in the area (Schnell, 2007). These demographics are very narrow, but with the expansion of CSAs nationwide, this alternative food network may have the potential to reach a wider range of people in the future.

Member Satisfaction

In examining the member satisfaction of 5 mid-Atlantic CSAs, Lang (2005) found that the more time a shareholder spent on the farm, the greater percentage of produce they consumed, and the more they supported sustainable agricultural practices, the higher level of satisfaction with membership. This leads to greater member retention over years. One of the most difficult aspects of a CSA membership from a consumer's perspective is the new way in which food is now entering their home (Goland, 2002). This requires new preparation techniques, new knowledge of dishes that include these foods, and ways to preserve produce that cannot be consumed immediately. Depending on the level of involvement of a consumer, this challenge can lead to increased satisfaction or increased discouragement and frustration with the consumer possibly choosing to discontinue their CSA membership (Goland, 2002).

One of the assumptions associated with joining a CSA is that a consumer will become included in a community of farmers and like-minded members. While one study documented this association and consumer satisfaction soared with the total CSA experience (Cone & Myhre, 2000), many other CSA shareholders did not report a high

sense of community associated with their CSA (Cone & Myhre, 2000; Russell & Zepeda, 2008). Most farms foster relationships of trust between farmers and members, but the members do not necessarily engage as would be expected (Cone & Myhre, 2000). The increasing number of members involved in a single CSA farm can also be detrimental to the experience as there is an even greater disconnect between farmer and shareholder (Henderson & Van En, 1999). The average size of a CSA farm is 15 acres, but as benefits and desire for profits increase, farmers may be tempted to increase the size of their farm (Lass, et al., 2003). This could result in the CSA losing members for a lack of satisfaction and further increase the farm's cost of production, marketing, and recruiting new members (Guthman, et al., 2006).

CSA Struggles

Several of the difficulties facing CSA farmers are the high turnover rate of memberships and the challenge of maintaining member satisfaction (Kane & Lohr, 1997; Oberholtzer & Project, 2004; Russell & Zepeda, 2008). Farmers work to retain shareholders each season by offering an acceptable quantity, quality and variety of produce, maintaining good communication with members, and including an element of choice in the shares (Oberholtzer & Project, 2004). Despite this, one of the main reasons that people choose not to renew their CSA membership is because of a lack of choice in their weekly share (Perez, et al., 2003).

While some farms find difficulties in maintaining members, a study conducted across several farms in Iowa identified much simpler problems for CSA farmers – labor cost and infrastructure (Janssen, 2010). Because CSA farms are built on sustainable agriculture principles, they try to avoid over-mechanized farming practices and,

therefore, rely heavily on labor. This can be one of a farm's biggest expenses and each person can only work a certain amount of land, therefore increasing the cost of labor with increased demand for CSA shares (Janssen, 2010; Oberholtzer & Project, 2004). While some farms only attribute a portion of income to CSA membership, other farms were created specifically with the intention to fill a CSA niche (Janssen, 2010; Lass, et al., 2003; Oberholtzer & Project, 2004). Most farmers do not expect CSA members to participate in working the fields, though working CSA shares, in which members exchange hours in the fields for their weekly share, are becoming more popular (Goland, 2002; Oberholtzer & Project, 2004). This is found to increase consumers' sense of community and overall satisfaction with the farm, leading to prolonged membership.

CSA Economics

Though the average CSA member places more value on the farmers' attitudes on sustainability and producing the food than quantity or price, one of the increasing problems with the current food system is the inaccessibility of produce because of cost, specifically for low-income consumers (Russell & Zepeda, 2008). The average cost of a CSA share nationwide is $412, designed to feed about 5 people, and is typically less than what the same quantity of organic produce would cost in a supermarket (Goland, 2002; Lass, et al., 2003). However, low-income consumers may not have this sum of money available all at once. As a result, farms have begun to allow CSA membership dues to be paid over extended period of time as well as accept WIC payments and may offer free shares to needy families (Goland, 2002; Kane & Lohr, 1997; Lang, 2010). It should be noted most CSA farmers are willing to encourage low-income consumer participation, but when a farm's income is based largely on CSA participation, lowering share cost is

difficult (Guthman, et al., 2006). Additionally, when the typical CSA member does not place high value on cost of membership relative to equivalent produce prices in the grocery store, it is hard to retain them year after year.

Changing Behaviors

In addition to the current high prices of produce in the U.S., other major challenges with the food system are access to fresh fruits and vegetables and healthful diet behaviors (Drewnowski & Specter, 2004). Many studies have found through surveys that CSA members believe they are increasing the quantity and variety of their produce consumption because of their membership (Goland, 2002; Kane & Lohr, 1997; Oberholtzer & Project, 2004; Perez, et al., 2003). Shareholders have also reported increasing their healthy eating habits, eating out less often, and consuming better quality food (Cone & Myhre, 2000; Perez, et al., 2003; Russell & Zepeda, 2008). Undoubtedly, utilizing a CSA to its full extent requires a change in behavior due to the sheer volume and variety of food being delivered (Goland, 2002). However, when delving deeper into what exactly CSA members are consuming, Goland found that consumers may be having a more difficult time incorporating CSA produce into meals than is assumed. That study, however, only investigated dinner meals and not full dietary intake, warranting the need for further research (Goland, 2002).

This Project

The current food system is experiencing a shift away from the highly globalized food system and into more direct marketing outlets (Timmons & Wang, 2010). Much of the current research surrounding CSAs is qualitative and designed to inform farmers about their customers and how to best meet their needs. However, this trend in alternative

food networks is becoming so much more popular, quantitative assessments of the change in the diets of CSA members are needed. CSA shareholders in several studies expressed difficulty in preparing the amount of produce and having knowledge about the wide variety of food received even though this abundance was identified as a main reason for joining (Goland, 2002). Conversely, these were often identified as reasons to terminate membership.

Recently, the American Dietetics Association published a paper calling for more studies examining the effects that alternative food networks are having on diets across the country (McCormack et al., 2010). Here, the researchers summarized the current research from farmers markets and community gardens, but the impacts of CSA membership on diets have yet to be examined. Specifically, the identified needs were for longer term assessments, in and out of the growing season, with the use of control groups to compare the diets and inclusion of low income populations (McCormack, et al., 2010). The current research project examines two of the three identified needs.

If CSA members are consuming more produce than the average consumer, diet quality will improve while potentially decreasing overweight, obesity, and disease rates. This can be useful for farmers and farm managers in marketing the 'healthfulness of a CSA membership' and increasing participation in communities nationwide. Though most CSA members have similar characteristics, CSA memberships could further be marketed to low-income populations who are known to have lower diet quality and higher disease rates.

Dietary Assessment Method

To assess dietary changes, an appropriate method for dietary analysis needs to be selected. The aim of this project was to capture fruit and vegetable intake of a population longitudinally. Also, this project had minimal supporting resources. In conducting dietary assessments, there are three main options from which to choose: 3-day food records, food frequency questionnaires, and 24-hour recalls (Agudo, 2005; Lee & Nieman, 2009).

Traditionally, the 3-day food record is used for individuals to assess typical eating patterns by including two weekdays and one weekend day. This requires much compliance from participants and places a high burden on them. It also potentially leads participants to change their eating patterns by eating less or what is perceived as healthier based on the fact that everything consumed must be recorded. When specifically looking at fruit and vegetable intake patterns, 3-day food records are not used for their heavy burden when only a particular part of their diet needs to be examined (Agudo, 2005).

A food frequency questionnaire (FFQ) is self-administered, listing specific foods or food groups that individuals consume to estimate their intake over an extended period of time (Agudo, 2005). This list can be tailored to fit different cultures or narrowed to focus on specific food groups and its application is relatively easy with a literate sample (Lee & Nieman, 2009). While this would be feasible for the present research design, FFQs do not account for seasonal variability and are better for ranking levels of intake rather than quantity of intake, which was needed in this study (Agudo, 2005).

Therefore, the third method of dietary assessment of 24-hour recalls was utilized. Twenty-four hour recalls have several strengths and limitations, but their overall design is most conducive to this study. First, 24-hour recalls are “appropriate to measure current

intake in groups" (Agudo, 2005). They do not portray individual diets very well because of day-to-day variations, but when used on a group basis, their validity is increased. Recall bias is minimized because participants need only to remember the previous days' eating habits. The 24-hour recall has been validated using the 5 pass automated multiple pass method (AMPM) by the USDA, which involves reviewing intake 5 times while probing into different specifics of the diet (Raper et al., 2004). Even more appropriate, a focused recall record can be used, which probes targeted food groups, and can be completed in less time with minimal staff training (Agudo, 2005).

Hypothesis

The hypothesis of this project is that diets of CSA members will include a higher and more varied intake of fruits and vegetables. To evaluate this hypothesis, the dietary intake of 20 members from the Colorado State University (CSU) CSA, Grant Farms CSA, and a control group of community members were measured. This was done by 24-hour recalls, using the multiple pass method and probing targeted at fruit and vegetable intake, at 3 different time points over 6 months.

CHAPTER III

METHODS AND MATERIALS

Introduction

Northern Colorado, specifically Larimer County, has an abundance of Community Supported Agriculture (CSA) farms. Happy Heart Farm was the first CSA in the state of Colorado, starting in 1983 in Fort Collins by Dennis and Bailey Stenson and still operating today ("Happy Heart Farm CSA," 2011). Grant Family Farms is one of the largest nationally certified organic farms located just northwest of Fort Collins in Wellington, CO (Grant Family Farms, 2010). Though Grant Family Farms produces over 3,000 CSA shares, this accounts for only a small portion of their total farm operations as they also supply organic produce worldwide. In contrast, Larimer County is also home to numerous smaller CSAs – including Happy Heart Farm, Wolf Moon Farms, Native Hill Farm, the Colorado State University CSA, and Cresset Community Farm ("Community Supported Agriculture," 2010). This abundance and diversity in local food suppliers allows for an adequate sample to be obtained of CSA members in order to examine dietary patterns.

Study Design and Protocol

Data for this longitudinal study examining the dietary effects of CSA membership, specifically fruit and vegetable intake, were collected over a 6-month period of time (July – December 2010). Three, 24-hour dietary recalls were collected by phone to assess the components of each participant's diet using the automated multiple-pass

method (AMPM) (Raper, et al., 2004), specifically focusing probing questions on fruit, vegetable, and leafy green consumption. The study met criteria for Institutional Review Board approval at Colorado State University (Protocol #10-1817H).

The first 24-hour recall was recorded to obtain a baseline reading on a participant's typical diet. This was taken in the beginning to middle of July (July 5 – 17) as the CSAs had started in mid-June/beginning of July and produce variety and quantity were limited. The second 24-hour recall was taken during the peak of the season, from August 30 to September 9. The final 24-hour recall was taken after the season ended, in late November and early December (November 30 – December 5). This was used as an assessment of whether CSA members' diets had maintained the expected increase in produce consumption earlier in the season or if their diets were more similar to the control groups' at this point in time.

Study Population

This study included 61 total participants - 21 from Grant Farms CSA (Northern Colorado members), 20 CSU CSA members, and 20 non-CSA members. The distinction between CSU CSA members and Grant Farms members was made because of the considerable size difference between the farms. Grant Family Farms extends over 2,000 acres in Wellington, CO and has a much larger production scale than the other, smaller produce farms in Larimer County. This size difference might affect the amount and variety of produce members receive and could therefore impact dietary quality. Grant Family Farms serves an audience throughout Colorado, but only members that were located in northern Colorado, specifically Larimer County, were included. Also, control

group members needed to be located in Fort Collins, CO to account for any geographical differences in produce availability during the season.

To get a more accurate description of a typical diet, any students, faculty, or staff from Colorado State University's Food Science, Human Nutrition, and Health and Exercise Science departments as well as people working in nutrition-related fields were excluded from participating. An inclusion criterion of age was used to select participants over the age of 18 and only one member from each household was able to participate. All study participants had to reside in northern Colorado for the entire study period.

Recruitment

After developing the concept for this study, farm managers of the CSU CSA and Grant Family Farms CSA were contacted to receive approval to recruit from their participants. CSA as well as non-CSA members were recruited primarily through the Colorado State University (CSU) Faculty and Staff listserv. Further recruiting was done with permission through the CSU CSA email list. Even after this additional measure, CSU CSA members were underrepresented and additional small-farm CSA members were included (1 from Wolf Moon Farms and 2 from Happy Heart Farm). Sufficient control group numbers were also not received through the CSU listserv, so further recruitment (n=8) took place at the Larimer County Farmers Market.

Subjects contacted the research team through email and, subsequently, received a consent letter detailing the study (Appendix A). If they were still interested in participating given the conditions of the study, they returned a completed entry questionnaire to ensure they met all inclusion criteria (Appendix B).

Tools

Before beginning the study, an entry questionnaire was distributed to participants including questions related to demographics such as gender, income, employment, education level, and years of involvement in the CSA as well as the best time to contact the participant for the 24-hour recall phone interviews. Other factors that might have impacted the composition of an individuals' diet, such as vegetarianism, diet restrictions such as lactose intolerance, or any measures for personal health or beliefs, and involvement in a fruit share in addition to regular CSA membership, were collected for potential analysis (Appendix B). A phone call script was developed for the study based on the AMPM to ensure that each participant, regardless of treatment, received the same amount of probing into his or her daily food intake (Appendix C).

Data Collection

Upon recruitment, each participant was assigned an identification number to be used in maintaining confidentiality. The phone call interviews lasted approximately fifteen minutes and accounted for the previous days' dietary intake for each participant. Probing within the AMPM model entailed asking for specifics on quantity, variety, and preparation methods only in regards to fruits and vegetables. Even further, participants were asked to quantify the amounts of fruits and vegetables present in mixed dishes such as casseroles or omelets. Each participant's dietary information was recorded during the phone call and reviewed immediately after to ensure all details were included.

Data Analysis

From the 24-hour recalls, amount and variety of fruits and vegetables were quantified using 8 variables (amount fruit, amount vegetables, amount total, varieties of

fruit, varieties of vegetables, total variety, leafy greens cooked, leafy greens raw). Researchers entered the recall data into spreadsheets matched with the corresponding study ID number. Greens were included first in the vegetable category as standardized amounts according to USDA standards, and then further divided into separate categories of cooked greens or raw greens. Inclusion criteria for fruits and vegetables as well as serving sizes followed the USDA Dietary Guidelines (USDA/HHS, 2010). White potatoes and French fries were included, but potato chips were excluded. Any further food decisions about quantity and inclusion were documented to maintain consistency across participants (Appendix D). Variety was quantified by totaling the number of different fruits and vegetables consumed in a 24-hour period. Specific types of fruit or vegetables were not differentiated for (such as Gala or Granny Smith apple).

Data were examined based on time point, group classification, and outcome variable. Possible confounding factors such as age, gender, income, education, vegetarianism, dietary restrictions, number of years as a CSA member, and fruit shares were examined.

The data analysis for this paper was generated using SAS software, Version 9.2 of the SAS System for Windows 7. Copyright © 2010 SAS Institute Inc. SAS and all other SAS Institute Inc. product or service names are registered trademarks of SAS Institute Inc., Cary, NC, USA. Chi square analyses compared distribution of demographic variables by group. Analysis of variance (ANOVA) was used to compare outcome measures according to group and time. Analysis of covariance (ANCOVA) compared outcome measures by group and time controlling for Time 1 as well as whether or not participants had a fruit share. Though the typical cut-off for statistical significance

($p<0.05$) was recognized for this study, p-values of less than 0.1 were noted as trends toward statistical significance. Given the small sample size, it is proposed that with larger population, these trends would reach true statistical significance.

CHAPTER IV

RESULTS

Demographics of Study Population

The Colorado State University (CSU) CSA, Grant Family Farms (GFF) CSA, and non-CSA (NON) groups had very similar demographic characteristics (Table 1). Groups were similarly dispersed by gender, age, education, income, vegetarianism, and other diet restrictions. The only factors that differed significantly were years as CSA members and recipients of fruit shares because of the inapplicability to non-CSA members. The majority of participants were highly educated (59% with advanced degree) and female (85% of all participants), with an even distribution among the age and income categories. Eleven percent of participants identified themselves as vegetarian and 30% had diet restrictions beyond vegetarianism.

Baseline Consumption of Fruits and Vegetables

At baseline, before the start of the CSA season, CSU CSA participants were consuming a higher variety of vegetables (5.40 [0.55]) and higher amounts of cooked leafy greens (0.33 [0.10]) than NON participants (4.10 [0.55] and 0.08 [0.10], respectively) (Table 2). GFF participants were consuming more than double the amount of raw leafy greens (1.92 [0.36]) than NON participants (0.88 [0.37]). These numbers indicate a trend towards statistical significance ($p<0.1$). Aside from these minute differences, the diets between CSU, GFF, and NON participants were similar at this time point.

Table 1. Characteristics of study participants according to group

Demographic Variable	CSU (n=20)	GFF (n=21)	NON (n=20)	Total (n=61)
		n (%)		
Gender				
Male	1 (5%)	3 (14%)	5 (25%)	9 (15%)
Female	19 (95%)	18 (86%)	15 (75%)	52 (85%)
Age - years				
≤35	9 (45%)	11 (52%)	11 (55%)	31 (51%)
≥36	11 (55%)	10 (48%)	9 (45%)	30 (49%)
Education Level				
Some college/ College degree	6 (30%)	8 (38.1%)	11 (55%)	25 (41%)
Advanced degree	14 (60%)	13 (61.9%)	9 (45%)	36 (59%)
Income				
≤$60,000	8 (40%)	4 (19%)	7 (39%)	19 (32%)
$61,000-$90,000	6 (30%)	7 (33%)	7 (39%)	20 (34%)
>$90,000	6 (30%)	10 (48%)	4 (22%)	20 (34%)
Years in CSA				
First year	5 (25%)	8 (38%)	N/A	13 (32%)
1-2 years	6 (30%)	9 (43%)		15 (37%)
3-4 years	8 (40%)	4 (19%)		12 (29%)
≥5 years	1 (5%)	0 (0%)		1 (2%)
Vegetarian (Y)	3 (15%)	0 (0%)	4 (20%)	7 (11%)
Other Diet Restrictions (Y)	4 (20%)	6 (29%)	8 (40%)	18 (30%)
Fruit Share (Y)	14 (74%)	10 (53%)	N/A	24 (59%)

Raw numbers may not equal total group numbers because of lack of response.

Table 2. Time 1 (prior to CSA season): Fruit and vegetable outcome according to group

Dietary Component[1]	CSU (n=20)	GFF (n=21)	NON (n=20)
	Least Square Mean (SEM)		
Amount of Fruit	1.59 (0.34)	1.57 (0.33)	1.70 (0.34)
Amount of Vegetables	2.49 (0.30)	2.08 (0.29)	1.94 (0.30)
Amount Total	4.09 (0.55)	3.65 (0.53)	3.64 (0.55)
Variety of Fruit	2.30 (0.44)	2.76 (0.42)	2.10 (0.44)
Variety of Vegetables	5.40 (0.55)[a]	4.29 (0.53)	4.10 (0.55)[a]
Variety Total	7.55 (0.79)	7.05 (0.77)	6.20 (0.79)
Leafy Greens - Cooked	0.33 (0.10)[a]	0.15 (0.10)	0.08 (0.10)[a]
Leafy Greens - Raw	1.23 (0.37)	1.92 (0.36)[a]	0.88 (0.37)[a]

a – LSM with common letter superscript in rows are close to significantly different ($p < 0.1$) according to ANCOVA analysis, using fruit share status as a covariate
[1] – Amount of fruit and vegetables as per USDA Dietary Guideline servings- ½ cup fruit/vegetable, 1 cup of raw leafy greens = 1 serving (USDA, 2010); Variety counted for each different category of fruit and vegetable consumed; Leafy greens (cooked and raw) measured in cups, not servings

By demographics at baseline, women were consuming less fruit (1.35 [0.22]) and less total fruits and vegetables (3.57 [0.34]) than male participants (2.38 [0.38], $p<0.01$ and 4.90 [0.59], $p<0.1$, respectively) (Table 3). Older participants (≥36 years) were consuming more vegetables (2.57 [0.26]) and total fruits and vegetables (4.61 [0.45]) than participants 35 years and younger (2.16 [0.25], 3.86 [0.43], respectively; $p<0.1$ for both). Also, they had a higher variety of fruits (2.54 [0.40]), vegetables (5.84 [0.51]), and total fruits and vegetables (8.36 [0.71]) than their younger counterparts (1.65 [0.38], $p<0.1$; 4.20 [0.48], $p<0.01$; 5.91 [0.68], $p<0.01$, respectively). More highly educated participants consumed more fruit ($p<0.001$), vegetables ($p<0.0001$), total fruits and vegetables ($p<0.0001$), and cooked ($p<0.1$) and raw ($p<0.001$) leafy greens than those with some college or an undergraduate degree. The more highly educated participants also incorporated an increased variety of fruit ($p<0.01$), vegetables ($p<0.1$), and total variety of fruits and vegetables in their diet ($p<0.01$) (Table 3). Conversely, wealthier

participants consumed fewer servings and less variety of all outcome variables; most of these differences are significant (p<0.01). Vegetarianism did not have an effect on overall diet except in variety of vegetables consumed (5.70 [0.73] for vegetarians, 4.34 [0.32] for non-vegetarians; p<0.1) and the identification of other diet restrictions by participants had no effect on any of the examined outcome variables of their diet.

Peak of CSA Season Fruit and Vegetable Consumption

After attaining a baseline assessment of the study participants' diets, the next two 24-hour dietary recalls (peak of CSA season and post-CSA season) were analyzed using ANCOVA with Time 1 and fruit share status as covariates (Table 4). At the peak of CSA season (T_2), GFF participants were consuming more vegetables (2.96 [0.26]) and more total fruits and vegetables (4.45 [0.40]) than NON participants (2.16 [0.29], p<0.1; 3.38 [0.45] p<0.1, respectively). Both CSU and GFF participants had an increased variety of vegetables over NON participants (p<0.01 and p<0.001, respectively) and participants from both CSAs had higher total variety (p<0.01) also at the second time point. CSU participants were consuming more cooked leafy greens (0.29 [0.09]) than NON (0.04 [0.09], p<0.1) at T_2; however, these values differed by only a quarter of a serving.

Post-CSA Season Fruit and Vegetable Consumption

After the CSA season had ended (T_3), the variety of vegetables consumed remained slightly higher for CSU participants than NON participants (4.18 [0.52] versus 2.83 [0.54], respectively; p<0.1) and total variety was higher for both CSA groups (CSU: 5.92 [0.65]; GFF: 5.77 [0.65]) than NON (4.04 [0.68]; p<0.1) (Table 4). The other categories returned to similar or lower values than at baseline.

Table 3. Time 1 (prior to CSA season) baseline dietary variables by demographics across all participants[1]

Demographic Variable	Amount Fruit	Amount Vegetables	Amount Total	Variety Fruit	Variety Vegetables	Variety Total	Cooked Leafy Greens	Raw Leafy Greens
				Least Square Mean (SEM)				
Gender								
Male	2.38 (0.38)^{a}	2.52 (0.34)	4.90 (0.59)$^{\#}$	2.09 (0.52)	5.01 (0.67)	7.15 (0.93)	0.08 (0.13)	1.66 (0.45)
Female	1.35 (0.22)^{a}	2.21 (0.20)	3.57 (0.34)$^{\#}$	2.10 (0.30)	5.02 (0.38)	7.12 (0.53)	0.09 (0.07)	1.15 (0.26)
Age - years								
≤35	1.71 (0.28)	2.16 (0.25)$^{\#}$	3.86 (0.43)$^{\#}$	1.65 (0.38)$^{\#}$	4.20 (0.48)^{b}	5.91 (0.68)^{b}	0.10 (0.09)	1.19 (0.33)
≥36	2.03 (0.29)	2.57 (0.26)$^{\#}$	4.61 (0.45)$^{\#}$	2.54 (0.40)$^{\#}$	5.84 (0.51)^{b}	8.36 (0.71)^{b}	0.06 (0.10)	1.62 (0.34)
Education Level								
Some college/ College degree	1.34 (0.29)^{b}	1.84 (0.26)^{c}	3.18 (0.46)^{c}	1.55 (0.40)^{a}	4.48 (0.51)$^{\#}$	6.09 (0.71)^{a}	0.00 (0.10)$^{\#}$	0.80 (0.35)^{b}
Advanced degree	2.40 (0.29)^{b}	2.90 (0.26)^{c}	5.29 (0.44)^{c}	2.65 (0.39)^{a}	5.56 (0.50)$^{\#}$	8.19 (0.69)^{a}	0.16 (0.10)$^{\#}$	2.00 (0.34)^{b}
Income								
≤$60,000	2.16 (0.32)^{a}	2.96 (0.29)^{c}	5.13 (0.49)^{c}	2.32 (0.43)	5.72 (0.55)$^{\#\dagger}$	8.07 (0.77)$^{\#}$	0.11 (0.11)	2.12 (0.37)$^{a\#}$
$61,000-$90,000	2.31 (0.31)^{b}	2.41 (0.28)$^{\#}$	4.72 (0.48)^{b}	2.14 (0.42)	4.73 (0.54)$^{\#}$	6.80 (0.75)	0.06 (0.10)	1.23 (0.36)$^{\#}$
>$90,000	1.13 (0.32)^{ab}	1.73 (0.29)$^{c\#}$	2.85 (0.50)^{cb}	1.83 (0.44)	4.61 (0.56)†	6.54 (0.78)$^{\#}$	0.06 (0.11)	0.85 (0.38)^{a}
Vegetarian								
No	1.82 (0.19)	2.09 (0.17)	3.91 (0.29)	2.23 (0.25)	4.34 (0.32)$^{\#}$	6.55 (0.45)	0.17 (0.06)	1.29 (0.22)
Yes	1.92 (0.42)	2.64 (0.37)	4.56 (0.65)	1.97 (0.57)	5.70 (0.73)$^{\#}$	7.73 (1.01)	-0.01 (0.14)	1.52 (0.49)
Other Diet Restrictions								
No	1.96 (0.25)	2.48 (0.23)	4.45 (0.39)	2.28 (0.34)	5.08 (0.44)	7.33 (0.61)	0.12 (0.08)	1.63 (0.30)
Yes	1.78 (0.33)	2.25 (0.29)	4.02 (0.51)	1.91 (0.44)	4.96 (0.57)	6.94 (0.79)	0.04 (0.11)	1.17 (0.39)

#,† = $p<0.1$, $a = p<0.01$, $b = p<0.001$, $c = p<0.0001$

Numbers with common superscript symbols or letters denote significant differences within columns of individual demographic variables

[1] – Amount of fruit and vegetables as per USDA Dietary Guideline servings- ½ cup fruit/vegetable, 1 cup of raw leafy greens = 1 serving (USDA, 2010); Variety counted for each different category of fruit and vegetable consumed; Leafy greens (cooked and raw) measured in cups, not servings

Table 4. Time 2 and 3[1]: Fruit and vegetable consumption according to group

Dietary Component[2]	Time	CSU T_2 (n=20) T_3 (n=20)	GFF T_2 (n=20) T_3 (n=19)	NON T_2 (n=18) T_3 (n=19)
		Least Square Mean (SEM)[3]		
Amount of Fruit				
	T_2	1.64 (0.27)	1.47 (0.26)	1.18 (0.29)
	T_3	1.42 (0.27)	1.17 (0.26)	1.05 (0.28)
Amount of Vegetables				
	T_2	2.48 (0.27)	2.96 (0.26)$^{\#a}$	2.16 (0.29)$^{\#}$
	T_3	2.40 (0.27)	2.01 (0.27)^{a}	1.83 (0.28)
Amount Total				
	T_2	4.06 (0.42)	4.45 (0.40)$^{\#}$	3.38 (0.45)$^{\#}$
	T_3	3.76 (0.42)	3.21 (0.42)	2.83 (0.45)
Variety of Fruit				
	T_2	1.94 (0.29)	1.37 (0.28)	1.61 (0.31)
	T_3	1.72 (0.29)	1.64 (0.29)	1.25 (0.30)
Variety of Vegetables				
	T_2	5.66 (0.52)^{a†}	6.10 (0.50)^{bc}	3.13 (0.55)^{ac}
	T_3	4.18 (0.52)$^{\#\dagger}$	4.09 (0.52)^{b}	2.83 (0.54)$^{\#}$
Variety Total				
	T_2	7.60 (0.65)$^{a\beta}$	7.50 (0.63)$^{b\mu}$	4.71 (0.70)^{ab}
	T_3	5.92 (0.65)$^{\#\beta}$	5.77 (0.65)$^{\dagger\mu}$	4.04 (0.68)$^{\#\dagger}$
Leafy Greens - Cooked				
	T_2	0.29 (0.09)$^{\#\dagger}$	0.05 (0.08)	0.04 (0.09)$^{\#}$
	T_3	0.00 (0.09)†	0.15 (0.09)	0.10 (0.09)
Leafy Greens - Raw				
	T_2	0.63 (0.27)	0.76 (0.27)	1.14 (0.29)
	T_3	0.60 (0.27)	0.87 (0.27)	0.77 (0.29)

#, †, μ, β = $p<0.1$; *a, b* = $p<0.01$; *c* = $p<0.001$

Numbers with same superscript symbols/letters indicate significant differences across rows and columns within dietary component variables

[1] – T_2 – peak of CSA season, T_3 – post CSA season

[2] – Amount of fruit and vegetables as per USDA Dietary Guideline servings- ½ cup fruit/vegetable, 1 cup of raw leafy greens = 1 serving (USDA, 2010); Variety counted for each different category of fruit and vegetable consumed; Leafy greens (cooked and raw) measured in cups, not servings

[3] – ANCOVA analysis using Time 1(prior to CSA season) and fruit share status as covariates

Differences between Peak-CSA Season and Post-CSA Season Consumption

The amount of fruit and variety of fruit remained relatively consistent throughout Times 2 and 3 of the study period throughout all of the groups (Table 4). Also, the diets of non-CSA members had no statistically significant changes in quantity or variety of fruit, vegetable, or leafy green intake across the study period. Amount of vegetables remained relatively constant except for a reduction in about 1 full serving from Time 2 to Time 3 in GFF participants (2.96 [0.26] at T_2 to 2.01 [0.27] at T_3; $p<0.01$). There was a slight decrease in the variety of vegetables consumed among CSU participants (5.66 [0.52] at T_2 to 4.18 [0.52] at T_3; $p<0.1$) with an even greater decrease among GFF participants (6.10 [0.50] at T_2 to 4.09 [0.52] at T_3; $p<0.01$). Similarly, total variety of fruits and vegetables decreased slightly between Times 2 and 3 for both CSU (7.60 [0.65] at T_2 to 5.92 [0.65] at T_3; $p<0.1$) and GFF (7.50 [0.63] at T_2 to 5.77 [0.65] at T_3; $p<0.1$) participants. Among CSU participants, the intake of cooked leafy greens at Time 2 (0.29 [0.09]) was decreased to none at Time 3 (0.00 [0.09]; $p<0.1$). Whether statistically significant or not, there was a decrease across all groups for every dietary component from Time 2 to Time 3, except for the variety of fruit consumed by GFF participants which increased from 1.37 (0.28) at Time 2 to 1.64 (0.29) at Time 3.

CHAPTER V

DISCUSSION

Demographics of Study Participants

The population of Larimer County, CO proved to be well-suited for studying CSA populations. Schnell et al. (2007) identified previously that areas with higher prevalence of white-collar jobs and income are likely to have more CSAs per capita. As of 2009, the median income of Larimer County is roughly $5,000 above the national median ($55,676 vs. $50,221) and 49% of the Larimer County population had above an associate's degree, while the nation-wide average is only 35.4% (U.S. Census Bureau, 2009). These factors enabled the research team to identify two CSAs in Larimer County that were willing to participate and use both to compare to a control group of non-CSA members.

The demographics among this study population were evenly distributed across the groups of CSU, GFF, and NON (Table 1). Women were the predominant gender across the CSU, GFF, and NON groups (95%, 86%, and 75%, respectively). Age, stratified into categories of 35 and below or 36 and above, was evenly distributed between groups as well (45%, 52%, and 55% were 35 and below for CSU, GFF, and NON, respectively). As was consistent with the overall Larimer County (U.S. Census Bureau, 2009), there was a large proportion of study participants with advanced degrees, more so among CSA members (60% and 61.9% for CSU and GFF, respectively) than non-CSA members (45%), but not significantly different. These demographics of CSA participants were in

agreement with much of the published literature, in that participants are mainly women, highly educated, and affluent (Cone & Myhre, 2000; Goland, 2002; Russell & Zepeda, 2008).

Outcome Variables by Demographics

When examining the outcome variables by demographics at baseline, most follow previously established trends in the literature (Table 3). Older participants were consuming a higher amount and variety of fruits and vegetables as were more highly educated participants (Casagrande, et al., 2007). Male and female participants in this study consumed approximately the same amounts and varieties except for amount of fruit and total amount. Typically, the literature suggests, women consume higher rates of fruits and vegetables (Blanck et al., 2008), but the results from the study might be largely influenced by the small sample size, especially of men. One of the strongest associations not previously documented in the literature was the relationship between income of participants and their consumption of fruits and vegetables observed in this study. Here, participants making less than $60,000/year and those making between $61,000 and $90,000 were consuming higher amounts of fruits and vegetables than higher income participants (>$90,000/year), regardless of group stratification. Among previous studies, the inverse is widely documented where cost and perceived extensive preparation time of fruits and vegetables are inhibitors among lower-income populations (Casagrande, et al., 2007; Drewnowski & Darmon, 2005). However, in this study, the lowest income group would not be defined as low-income by national standards. Most notable was the highest intake of raw leafy greens in any demographic or study group at any time point was by the lowest income (≤$60,000/year) of study participants at baseline. Among a study of

farmers' market consumers, the most represented income population was that making $15,000 to $29,999 annually (Zepeda, 2009). This finding could potentially be broadened to include that of CSAs as those were the results observed here.

The sample population recruited for this study is representative of an unordinarily healthy population, which may have underestimated the actual impact of a CSA membership. In relation to the rest of the U.S., the population of Colorado is generally less overweight and obese and more active (Sapkota et al., 2005; Sherry et al., 2010), which are associated with higher fruit and vegetable consumption (Kushner & Choi, 2009). A portion of the control group was recruited from a local farmers' market, and therefore could have a higher priority of nutrition in their food selection (Zepeda, 2009), which could also decrease the differences observed between the control group and CSA groups.

While vegetarians have similar caloric intake to their non-vegetarian counterparts, there is an observable increase in fruit and vegetable consumption among vegetarians as partial compensation for the lack of meat in their diet (Robinson-O'Brien et al., 2009). This effect was not observed in this study (Table 3). However, the overall health conscious population that this sample was taken from may have inflated the intake values of all study participants.

Baseline Outcome Variables

At baseline, there was not a large difference in the diets between NON participants and both CSA groups (Table 2), the only slightly significant differences ($p<0.1$) being cooked and raw leafy greens and variety of vegetables. Intake of cooked leafy greens (0.33[0.10]) and variety of vegetables (5.40[0.55]) were higher for CSU

participants compared to NON participants (0.08[0.10] and 4.10[0.55], respectively) and raw leafy green intake was higher for GFF (1.92[0.36]) than NON (0.88[0.37]). At baseline, the CSA share distribution was in its third to fourth week. This should not have substantially affected the diets of CSA members, as they were only receiving leafy greens, but it may explain why these numbers differed. Also, the difference in cooked leafy greens was approximately a quarter of a cup, having little practical significance. The similarity between diets of the NON participants and CSA members is able to show the true impact of CSA membership above and beyond a typical diet for this sample of participants.

Amount of Fruits and Vegetables Consumed by Study Participants

The amount of fruits and vegetables consumed by CSA members was only slightly higher than that of NON participants in this study (Table 4). GFF had a significance of $p<0.1$ for amount of vegetables and amount total for Time 2 in comparison to NON, indicating a trend towards significant differences. Had the study included a larger sample size, a more accurate depiction of diet changes might have been observed and these differences may have reached statistical significance.

In relation to national averages of fruit and vegetable intake, the CDC uses data from the Behavioral Risk Factor Surveillance System (BRFSS) to estimate that 24.4% of the nation is consuming fruits and vegetables over 5 times a day (CDC, 2009). Similarly, it is estimated that 25.4% of Colorado is consuming fruits and vegetables 5 or more times a day. The problem with this data is that frequency is measured, not quantified amounts. NHANES from 1999-2002 estimated that the mean amount of fruits and vegetables being consumed in the U.S. is 3.04 servings (Casagrande, et al., 2007). Therefore, even if a

large percentage of Americans are consuming fruits and vegetables frequently, it does not necessarily mean the recommended amounts are being obtained. In this study, baseline measurements showed that all study participants were consuming more than the national average of total fruits and vegetables (Table 2), indicating further that this study sample is not representative of the average Americans. During the Peak of CSA season (Time 2) all study groups were consuming more than the national average of total fruits and vegetables, with GFF consuming the most (Table 4). At time 3, after the CSA season had ended, CSA members were still consuming more than the national average while NON had dropped below (Table 4). This suggests that CSA members may become accustomed to the amount provided to them during the season and aim to maintain this outside of the season, where non-CSA members may experience more highs and lows with produce consumption throughout the year.

Variety of Fruits and Vegetables Consumed by CSA Members

Though not much difference was observed in the quantity of fruits, vegetables, and leafy greens in diets of CSA versus non-CSA members over the 6 months studied, there was a significant increase in variety being exhibited in the CSA members' diets. As part of a CSA, members are not responsible for the selection of their produce and the CSA farms are more likely to be involved in crop rotation and experimenting with new varieties as well as incorporating enough variety to appeal to a wide audience, enabling a higher diversity of crops to be present in these members' diets (Lang, 2005). The mixture of produce available and exposure to new vegetables above and beyond what is found in the supermarket is one of the reasons that community members join CSAs (Perez, et al., 2003).

Though quantity is an important aspect to fruit and vegetable consumption, there is also a significant impact of higher variety on dietary quality. The Dietary Guidelines recommend a widely varied intake of vegetables to ensure nutrient requirements are being met (USDA/HHS, 2010). By including a wide variety of produce, more nutrients are included in the diet. For instance, a diet that includes iceberg lettuce and celery is going to have less nutrients than one comprised of swiss chard, beets, sweet potatoes, and carrots. It is the composition of the fruit and vegetable matrix as well as quantity that impacts the nutritional density and overall healthfulness of a diet (Wirt & Collins, 2009).

Differences between Time 2 and Time 3

As was anticipated, the amount and variety of produce consumed increased at Time 2 and declined at Time 3 across almost all groups (Table 4). This pattern is reflective of increased produce availability and consumption throughout summer and early fall. However, this trend was not consistent when looking at variety of fruit for Grant Family Farms participants (1.37[0.28] at Time 2 to 1.64[0.29] at Time 3) and was independent of fruit share participation, for this was controlled. This increase in fruit may be a result of CSA share decline and the consequent increase in fruit purchases from another outlet. Though intake values followed similar patterns across all groups, the participants from both CSAs were consistently consuming higher varieties of vegetables throughout the study period (Table 4).

The sustained increase in variety of produce consumed among CSA members into December of 2010 may be reflective of lifestyle habits carrying over out of CSA season and impacting purchasing patterns in the future. Grant Family Farms' CSA extends further into the winter than most CSAs in the region as their resources for food

production and storage are greater, but this seemed to produce no greater trend than the CSU participants. At the time of the third 24-hour recall, none of the dietary components differed significantly between CSU and GFF participants, but both had slightly significant ($p<0.1$) higher total variety compared to NON and CSU had slightly significant ($p<0.1$) higher variety of vegetables (Table 4). This may be predictive of CSA members' diets remaining diverse above that of NON participants into the winter months.

Strengths and Limitations

One of the most apparent limitations to the study was the small sample size that limited the power to find differences between groups and changes in diet. In the tables presented, a significance value of $p<0.1$ is noted to indicate a trend toward significance that would most likely have been seen with an increased sample size. Another limiting factor is that the study participants may not be representative of the typical American poplace, as the sample recruited is from a highly educated, healthier subset of the U.S. population and some control group subjects were obtained at farmers markets (n=8). This highly healthy and educated population provided the needed basis for the study, as a large number of CSAs are found within the region of Larimer County, CO, but further studies should aim to recruit a more diverse group of participants.

There were unavoidable confounders included in the study. Misclassification of participants may have occurred as share size or splitting a share was not accounted for in the initial entry questionnaire. This may be the reason for the similarities observed between CSA groups and NON participants in quantity of fruit and vegetable consumption, while showing an increase in variety among CSA members, but cannot be verified. Recall bias was minimized through the use of 24-hour dietary recalls as these

reduce the reliance on memory compared to a food frequency questionnaire (Lee & Nieman, 2009), but may have still existed in participants reporting because of lack of memory. Similarly, participants may have misreported their intakes for social desirability (Hebert et al., 2002). Observation bias may have impacted the results, as the researchers were not blinded to the participant's group in collecting data, but the use of the AMPM attempted to control for this. Also, a blinded research team entered the data. Results may have been further confounded by the estimation of portion sizes (Smith et al., 1997). Participants were not equipped with reference solid or liquid measurements, which may have introduced bias into the study.

However, having three very similar groups in this study enabled the researchers to see the actual impact of a CSA membership. The control group was comprised of people very likely to join a CSA- highly educated, female, and health conscious, just as the CSA members were. Therefore, though the impact on quantity was not observed, the increase in variety that the CSA members exhibited was likely a true relationship. Also, the high prevalence of CSAs in Larimer County enabled this study to be conducted across two CSAs in relation to a control group, further examining the differences between CSAs as well as between CSA and control. This enables further studies to be developed with larger sample sizes to examine how CSA memberships can differ and impact fruit and vegetable consumption using this research as a basis.

CHAPTER VI

CONCLUSIONS AND IMPLICATIONS

In accordance with the recommendations made by McCormack and colleagues (2010), this study examined the effects that alternative food networks (AFNs), specifically CSAs, are capable of producing on dietary patterns. Time and monetary constraints limited the scope of this project. Still, differences between CSA members and non-CSA members were seen, indicating the positive nutritional benefits a CSA membership is capable of producing. The dietary and lifestyle differences between this sample population and the typical American population are large and, therefore, a similar study should be replicated on a larger scale.

Research on CSAs is difficult to duplicate as every farm and region of the country is going to have different offerings and structure. However, in obtaining a large enough sample from across the country, these differences could potentially be muted enough to see overall, generalizable benefits. In addition, studies in the future should address low-income members of CSAs in and out of season, differences in rural versus urban areas, and look at dietary changes more frequently over a longer period of time. By recognizing the impact that CSAs can have on diets of consumers nationwide, more funding should be allocated to this area of community nutrition.

There are many motivators and barriers to fruit and vegetable consumption and the CSA model has the potential to bring down cost and increase availability to

consumers. In addition, though they are similar in nutritive qualities, the barriers and motivators for fruit and vegetable consumption are potentially much different. For instance, while fruits are easily taken “on-the-go”, some vegetables require extensive preparation, greater than any fruit. Similarly, the way that research and recommendations combine fruits and vegetables may need to change in the future. The basic CSA model includes only a vegetable share, though fruit shares are often offered at an additional cost, and adjusting to the increased variety and amount of vegetables provided is a factor to which all members must adjust. In this respect, if more studies look at vegetable consumption alone in regards to CSAs and other AFNs, a stronger relationship may be observed as this particular area could be seeing the largest amount of growth.

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APPENDIX A

PARTICIPANT CONSENT LETTER

June 14, 2010

Dear Prospective Research Candidate:

My name is Jess Hedden. I am a M.S. student in the Food Science and Human Nutrition Department at Colorado State University. My advisor, Garry Auld, Ph.D., R.D. Department of Food Science and Human Nutrition, and I are conducting a research project to identify how the eating patterns of CSA members differs from those who shop at a grocery store. The title of this research project is: *Effects of CSA Membership on Dietary Intake*. The project is my master's thesis. Dr. Auld is the Principal Investigator for this project, and I am a Co-Principal Investigator.

Community Supported Agriculture (CSA) is a growing alternative food system for which there is very limited research. There are currently over 2,500 CSAs nationwide and growing annually. Because of this, we want to use your experience to see if the CSAs are changing the way people eat and potentially find data to help support the promotion of CSAs. The overriding goal of this research is to examine the effect that membership in a CSA has on how people eat.

Your experience is very important to our understanding and this research. This study will involve a series of 4 phone call interviews from June to December asking you to describe what you ate the previous day. Before the study starts, you can specify when a good time to call will be and you will be notified of the weeks for which this will be happening. We expect the phone call process to take about 30-45 minutes and we hope you will agree to be interviewed. We ask that you maintain a typical eating pattern during the weeks you know you will be called and be honest with your responses – there are no right or wrong answers.

There are no known risks to participating in this study as the information you provide will be kept confidential and will not be linked to specific individuals. While there are no direct benefits to you personally, the researchers will provide the results of the study once it has concluded around March of 2011. Your participation in this research project is voluntary and you may decline to participate and withdraw from the interview at any time. You will not be compensated for participating in the phone call interviews. We will obtain your consent during a phone call before contacting you to take part in future parts of the study.

We hope that you will agree to participate. A member of our team will contact you and set up a time to conduct the proceeding interviews. If you would prefer to contact us first, please call Jess Hedden at 970-222-5879. If you have any questions about your rights as a volunteer in this research, contact Janell Barker, Human Research Administrator at 970-491-1655.We look forward to hearing from you.

Sincerely,

Jess Hedden Garry Auld, Ph.D.

Graduate Student Professor

CSAstudy2010@gmail.com auld@cahs.colostate.edu

970-222-5879 970-491-7429

Department of Food Science & Human Nutrition

Colorado State University

Fort Collins, CO 80523-1571

APPENDIX B

PARTICIPANT ENTRY QUESTIONNAIRE

NAME _____

ENTRY QUESTIONNAIRE

DEMOGRAPHICS

What is your gender? ☐ Male ☐ Female

What is your age? ☐ 18 – 20 ☐ 21-25 ☐ 26 - 29 ☐ 30 – 35
☐ 36 – 40 ☐ 41 – 45 ☐ 46 - 50 ☐ 51 – 55
☐ 56 – 60 ☐ 61 +

Highest level of education attained:

___ Some high school, HS degree, GED ___ Some college or technical education

___ College degree (Bachelors) ___ Advanced degree (Masters, Doctorate)

Estimated household income:

___ < $30,000 ___ $31,000-$60,000 ___ $61,000- $90,000 ___ >$90,000

Are you a vegetarian? ☐ yes ☐ no

Are you employed by the University? ☐ yes ☐ no

If so, which department? _____

Do you work in a health-related field? ☐ yes ☐ no

If so, what specifically? _____

Are you currently participating in any other research/experimental studies?

☐yes ☐ no

Do you currently have any restrictions to diet for health, personal, religious, or other reasons?

☐ yes ☐ no

If yes, please explain: _____

How many years have you been a member of a CSA?

□ this is my first year □ 1-2 □ 3-4 □ 5+

Have you been a member of only Grant Farms/CSU CSA? ☐ yes ☐ no

What other CSAs have you been a part of? _____

When is the best time to contact you for the 24-hour recall?

Please **rank** your top three (3) choices for **BOTH** day and time with 1 indicating your top choice:

DAY

__ Monday __Tuesday __Wednesday __Thursday __ Friday __ Saturday __Sunday

TIME

__ Morning (between 8am and 10 am) __ Mid-Morning (between 10 am and 12 noon)

__ Afternoon (between 12 noon and 3 pm) __Late Afternoon (between 3pm and 5pm)

__ Evening (between 5pm and 7pm) __Late Evening (between 7pm and 10pm)

What phone number would be best to contact you? _____

Thank you so much for your willingness to participating in this research!

APPENDIX C

24-HOUR RECALL PHONE SCRIPT

PHONE CALL SCRIPT – adapted from Raper et al's *An Overview of USDA's Dietary Intake Data System* in Journal of Food Composition and Analysis 17 (2004): 545-555.

Hello, this is _____ (phone callers name) from the CSU study on CSA membership, is _____ (participants name) there?

Would this be a good time to ask you about what you ate yesterday?

1. Quick List: "Let's start with yesterday morning when you woke up and work through the day."

2. Forgotten foods list:
   Probe with: any nonalcoholic beverages? Any alcoholic beverages? Cheese? Bread and rolls? Other foods? Any sweets/snacks**? Fruits? Whole or mixed? Vegetables- specifically leafy green types and quantity? Ask about mixed dishes that may contain fruits or vegetables**

3. Time and occasion – group according to meals

4. Detail and review – How much of each item was eaten? How was each meal prepared?

   Review time and occasion of each eating session

5. Final review – go over entire list and ask if there was anything forgotten

Ok, that is everything! If you think of anything else, please contact me at your earliest convenience. Have a great day!

APPENDIX D

FOOD DECISIONS

Food Decisions

no hummus
no onion rings
no potato chips
no jam/jelly
no fruit pies
no vegetable breads

yes refried beans
yes coleslaw
yes potato salad
yes salsa

Amounts:

1/2 cup dried fruit = 1 cup
1 leaf of lettuce = 1/4 cup
in total amounts of vegetables, 2 c. raw lettuce = 1 c. actual (Serving)
in amounts of cooked/raw leafy greens, 1 c. raw lettuce = 1 c. actual
1 apple = 1 cup
1 peach = 1 cup
1 pear = 1 cup
1 nectarine = 1 cup
1 banana = 1 cup
10 grapes = 1 cup
8 strawberries = 1 cup
12 baby carrots = 1 cup
2 med carrots = 1 cup
1 radish = 1/8 cup
1 tomato = 1 cup
1 beet = 1 cup
1 lrg sweet potato = 1 cup
4 apricots = 1 cup
6 asparagus = 1/2 cup
1 clementine = 1/2 cup
4 dates = 1/4 cup
6 broccoli florets = 1/2 cup
10 cherry tomatoes = 1 cup
1 fig = 1/2 cup (1/4 cup dried)
1 kiwi = 1/4 cup
roma tomato = 1/2 cup

Yes Soups:
Tomato
Potato
Lentil
Non-meat based chili