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INCREASING VEGETABLE INTAKE IN LOW-INCOME, RURAL APPALACHIAN FAMILIES

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ABSTRACT

Diets high in fruits and vegetables are likely to protect against various chronic diseases. However, most Americans do not meet daily vegetable intake recommendations. Our research investigated the process of vegetable selection for shared family meals within low-income, rural Appalachian families and used these data to develop and evaluate an intervention to improve family member vegetable intake. Our targeted vegetables were the protective deep orange, cruciferous and dark green leafy vegetables.

The first research step used eight focus groups, segmented by sex and vegetable-liker/disliker status, to investigate the process of family vegetable selection, especially of our target vegetables. Participants (n=61) in all segments reported more costs than rewards for serving vegetables. Past experiences, food preparer role expectations, and pleasing family member preferences led meal preparers to serve only a limited range of vegetables that were acceptable to all family members. Participants were unfamiliar with our target vegetables, did not know how to prepare them so they tasted good, and said that tasting samples or vegetable dishes might inspire serving them at family meals.

The second research step was an experimental community-based intervention, based on Social Cognitive Theory, which was designed to improve target vegetable serving and intake among rural Appalachian, low-income, middle-aged, married/cohabiting food preparers and their partners. Food preparers were randomized to the experimental or the control treatment. Experimental food preparers (n=25) attended 8 weekly lessons that eliminated commonly cited barriers to altering food choices by providing food preparers with skills, familiarity, knowledge and access to the target vegetables while highlighting ways to minimize cost, time and effort. Lessons used visual demonstrations, tasting opportunities, comparative data, handouts, and preparation of vegetable recipes (which food preparers took home to serve to their families).

Control food preparers (n=25) received 8 weekly mailed packets that included the same handouts and recipes given to experimentals.

Evaluation measures were completed by both food preparers and their partners using several questionnaires filled out at baseline, immediate post-test, and 3-month follow-up. Couple interviews were also conducted at baseline and immediate post-test to further enrich our understanding of participant experiences with the intervention. Initial impact analyses yielded few significant differences between original experimental and control treatments. However, subgroup analysis indicated food preparers in families reporting greater involvement of both parents and children in vegetable dish evaluation through a meal diary had significantly greater increases in intake and frequency of serving of target vegetables than those reporting poorer family involvement. Meal diary utilization appeared to enable some food preparers to identify ways to include our target vegetables in meals. Although not usually addressed in nutrition interventions targeting the food preparer, tools to support intra-family evaluation and perhaps negotiation are critical for instigating change in food choice.

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Chapter 1

Literature review

Study Overview

Diets high in fruits and vegetables may support weight control (Rolls et al., 2004) and are likely to protect against various chronic diseases including cancer, heart disease and diabetes (Bazzano, 2006; Van Duyn & Pivonka, 2000). Most Americans do not meet daily vegetable intake recommendations (Casagrande et al., 2007; Guenther et al., 2006; Kimmons et al., 2009), and low-income Americans eat even fewer vegetables than those with higher incomes (Casagrande et al., 2007; Darmon & Drewnowski, 2008; Krebs-Smith et al., 1995; Subar et al., 1995). The low-income population also suffers from more chronic diseases compared to their wealthier counterparts (US Department of Health and Human Services, 2000).

Nutrition education interventions designed to increase consumption of fruits and vegetables have resulted in modest changes in fruit and vegetable intake (Bowen & Beresford, 2002). A review of such interventions found that experimental groups increased their fruit and vegetable intake by an average of 0.6 daily servings more than controls at the first follow-up, but this decreased by over 50% at the second follow-up (Ammerman et al., 2002). Fruit and vegetable intake is commonly reported as a composite value (Anderson et al., 2001a; Havas et al, 1998; Havas et al., 2003; Shankar et al., 2007). When the two intakes are reported separately, the biggest contributor to any increase in fruit and vegetable consumption is often higher fruit rather than vegetable intake (Ammerman et al., 2001; Campbell et al., 1999; Devine et al., 2005; Stables et al., 2002). It is recommended that future nutrition interventions focus on increasing vegetable consumption specifically (Stables et al., 2002; Trudeau et al., 1998). Targeting the deep orange, cruciferous and dark green leafy vegetables is warranted, as they are especially protective against chronic disease (Van Duyn & Pivonka, 2000), however their intake is consistently low (Guenther et al., 2006; Johnston et al., 2000; Kimmons et al., 2009). Our organization of the protective vegetables differs from that used in the 2005 Dietary Guidelines where the cruciferous vegetables are not identified as a separate vegetable group. Instead the Dietary Guidelines include broccoli (along with the dark leafy greens) in the 'dark green' vegetable category and cauliflower/Brussels sprouts and cabbage in the 'other' vegetable category (US Department of Health and Human Services and USDA, 2005).

Nutrition interventions like those cited above often target the female food preparer, who does most meal planning, shopping and cooking and is considered the gatekeeper of the family diet (De Bourdeaudhuij, 1997; Harnack et al. 1998; Lewin, 1943). However, family member preferences have a large influence on food choices for family meals, and often make it difficult for women to introduce healthy foods to the family (Bradbard et al., 1997; Hartman et al., 1994; Krummel et al., 2002; Schafer et al., 1995). Husband's and children's preferences tend to control what is served at family meals (Brown & Miller, 2002; Kerr & Charles, 1986; Stratton & Bromley, 1999). In turn, women food preparers may forfeit serving things they prefer such as casseroles, certain vegetables and pasta in favor of things their husbands prefer such as meat and potatoes (Brown & Miller, 2002). A greater understanding is needed of the process whereby family members influence vegetable choices offered at family meals, particularly in low-income, rural Appalachia families. There are currently no documented methods to effectively involve the husband and children in introducing new vegetable choices, which appears necessary to improve acceptability of vegetables at shared family meals. It is also unclear whether food preparers trained in a nutrition education program can affect family member vegetable intake, as evaluation data is typically based on reported intake for the food preparer but not for other adult family members.

Objectives

This research first investigated the *process* of vegetable selection for shared family meals within low-income, rural Appalachian families. Then these data were used to develop and evaluate an intervention designed to improve family member (food preparer and partner) vegetable intake, with a key focus on the protective deep orange, cruciferous and dark green leafy vegetable groups.

Dissertation Content and Organization

This research was conducted in two steps as outlined in the objectives. As a result, this dissertation has four chapters. Chapter 1 provides a review of the literature including the health benefits of consuming fruits and vegetables, impact of family members on disease, cancer and heart disease prevalence among low-income populations, current fruit and vegetable intake in the US, interventions conducted to increase fruit and vegetable intake, intra-family influences on food choices, and influence of the family power hierarchy on food choices. This leads to the study rationale, hypotheses and description of dietary intake assessment and theoretical models used. Chapter 2 is a paper describing the first step using focus groups that has been accepted for publication in the Journal of Nutrition Education and Behavior. Chapter 3 is a paper describing the second step, which is an experimental intervention, and its results. A shortened version of this paper will be submitted to the Journal of the American Dietetic Association. Chapter 4 discusses how the findings of these two steps related to other studies, study limitations, the contribution to the field and implications for future research and practice.

Health Benefits of Fruit and Vegetable Intake

Heart disease and cancer are the two leading causes of death, one and two respectively, in the United States, jointly accounting for nearly half of all deaths in 2006 (Heron et al., 2009). Diets high in fruits and vegetables are thought to protect against heart disease and cancer as well as stroke, hypertension, diabetes, cataract formation and diverticulosis (Bazzano, 2006; Van Duyn & Pivonka, 2000). Additionally, high fruit and vegetable consumption can help control weight (Rolls et al., 2004). The increasing prevalence of obesity with its associated health risks has become a major concern in this country (Pi-Sunyer, 1999). In contrast to weight management focusing on restricting food choices, Rolls et al. (2004) suggest coupling the more positive advice of increasing consumption of low-energy-dense fruits and vegetables, which have few calories in relation to volume because of their high water content, with advice to decrease fat and energy intake for effective weight management. Because this provides satiation while controlling calories, feelings of deprivation are less and weight loss may be more sustainable. Interventions have shown low-energy-density eating is effective in helping to control weight (Ello-Martin et al., 2007; Greene et al., 2006) as well as hunger (Ello-Martin et al., 2007).

Fruits and vegetables contain many nutrients including dietary fiber, essential vitamins and minerals, and a host of phytochemicals (plant-derived compounds thought to have health benefits). Dietary fiber can bind to cancer-causing carcinogens and, because it draws water into the intestinal tract, it can dilute the carcinogens and move them through the digestive tract more quickly. Soluble fiber can also reduce serum cholesterol, which at high levels is a risk factor for heart disease (Van Duyn & Pivonka, 2000). Because it adds bulk but few calories, fiber can also increase satiety thus helping to control weight (Rolls et al., 2004).

Important vitamins, minerals and phytochemicals in fruits and vegetables include vitamins C and E, folic acid, potassium, selenium, zinc, carotenoids (beta carotene from deep orange vegetables, lutein from dark green leafy vegetables, lycopene), flavonoids, and indoles and sulfur-containing compounds from cruciferous vegetables. Most of these exert antioxidant effects in vitro and in animals (Van Duyn & Pivonka, 2000). Oxidative stress can damage DNA and lipids, resulting in increased cancer and heart disease risk. Antioxidants can inhibit or slow down oxidative stress, thereby potentially lowering the risk of these chronic diseases. Fruit and vegetable phytochemicals protect against chronic disease through complementary and overlapping mechanisms of action, summarized by Liu (2003). Liu (2003) suggests getting phytochemicals from a diverse diet of whole fruits and vegetables as opposed to supplements. Clinical studies on many antioxidant supplements have been shown to have no effect or to increase cancer incidence (Gaziano et al., 2009; Lee et al., 2005; Liu, 2003; Mason, 2009; Tanvetyanon & Bepler, 2008). Whole foods such as fruits and vegetables provide a complex combination of phytochemicals and other plant compounds that cannot be mimicked in a supplement. Additionally, consuming toxic amounts of phytochemicals is much more likely through supplement use. Phytochemicals provide health benefits at their naturally low levels in whole foods, but any compound can be toxic at high doses as found in supplements (Liu, 2003).

In summary, fruits and vegetables are sources of many nutrients and phytochemicals that may provide protection against chronic disease. Eating a variety of whole fruits and vegetables is the best way to get this protection.

Impact of Family Members on Disease

It is typically assumed there are two major influences on health: genetics and environment. These two factors influence nearly any health condition imaginable, but the majority of this discussion will focus on their influence on cancer. Roughly 20% of cancers are either inherited (caused by highly penetrant germ line mutations) or familial (could be caused by the interaction of genes, or the interaction of genes and the environment) (Nagy et al., 2004). This leaves a large proportion of cancer incidence to be explained by environmental factors. Family members share environmental and lifestyle factors such as diet, tobacco use, alcohol intake and sexual practices (Walach et al., 1998). Associations of cancer incidence between first-degree relatives and spouses can give insight into the contribution of genetics and environment on cancer risk.

Several studies have examined familial cancer risk of first-degree relatives using the Swedish Family-Cancer Database (Dong & Hemminki, 2001; Hemminki & Czene, 2002; Hemminki et al., 2004; Hemminki et al., 2008a). This is the largest population-based dataset on familial cancer that includes children born in Sweden since 1932 who are registered along with their biological parents as families (Hemminki et al. 2001a). Recent studies have found significant familial risks shared between parent and offspring for a number of cancers (Hemminki et al., 2004; Hemminki et al., 2008a). Hemminki et al. (2008b) used this database to calculate proportions of site-specific familial cancers (the proportion of each site-specific cancer in which two or more family members – parent and/or sibling – were diagnosed with the same cancer). Out of 34 cancer sites examined, the highest familial proportions were for prostate (20.15%), breast (13.58%) and colorectal (12.80%) cancer. In other words, 20.15% of prostate cancer patients had a parent and/or sibling with prostate cancer. Calculated familial proportions for these common cancers were similar to those of Goldgar et al. (1994), although there was less agreement between the two studies for less common cancers. Hemminki et al. (2008b) compared their calculated familial risk estimates for the common cancers with seven other studies and found results comparable within a few decimal places. Familial risks between parents and offspring among the studies were about 2.3 for prostate, 1.8 for breast, and 2.0 for colorectal cancer meaning, for example, an offspring is twice as likely to get colorectal cancer if a parent has it.

These studies revealed there is familial clustering of many site-specific cancers. However, it is impossible to distinguish environmental from genetic factors in studies of first-degree relatives. Spousal studies indicated more about environmental impact because spouses are genetically unrelated, but they can share decades of life together (Hemminki et al., 2001b). A few of these studies related to cancer are described below.

A few studies have looked at familial cancer risk among spouses, again using the Swedish Family-Cancer Database. Two such studies examined spouses in the database aged 50 years or older to allow sufficient time for cohabitation (Hemminki et al., 2001b; Hemminki & Jiang, 2002). Hemminki & Jiang (2002) defined spouses as the parents of the woman's first child who were cohabiting for at least 15 years. They found significant concordance within spousal pairs (i.e., spouses presented with the same cancer) for cancers of the stomach, lung and bladder. In an earlier study using the same database, Hemminki et al. (2001b) defined spouses as the parents of the last child of the couple (and did not consider cohabitation period). They found significant concordance within spousal pairs for stomach and lung cancers (as well as pancreatic cancer and melanoma when at least one spouse was diagnosed before age 50). Although these two studies used slightly different definitions for 'spouses,' both found significant spousal concordance for stomach and lung cancers plus one or two other cancers (bladder cancer, pancreatic cancers, and/or melanoma).

A population-based cohort study in northern California examined familial association for cancer among 25,670 married couples who were cancer-free at baseline and followed for 31 years

(Friedman & Quesenberry, 1999). This study found significant spousal concordance only for tongue and stomach cancers and for non-Hodgkin lymphoma. The cancers for which significant concordant associations were found in these three studies have strong environmental risk factors (i.e., smoking tobacco, *Helicobacter pylori* infection, shared diet, outdoor environment, heavy alcohol use, pesticide exposure). Some cancers assumed to be diet-related (i.e., colon, rectum) (World Cancer Research Fund/American Institute for Cancer Research, 2007) were not significantly associated between spouses in these three studies. However, these studies are all limited in that they did not gather dietary intake data nor consider environmental sharing earlier in life.

A population-based cohort study conducted in Japan did gather some dietary data (Izumi et al., 2004). The cohort started with 2601 cancer-free married couples, aged 40-84, who were followed for 14 years. Considering the incidence of all cancers combined, husbands and wives were at an increased risk for cancer when their spouses developed any type of cancer (note, only four couples had cancer in the same site – stomach: 2, lung: 1, colon: 1). Concordance of 'dietary habits' (defined as *frequency of intake* of nine items: fish, meat, fruits, soy products, eggs, dairy products, all vegetables except pickles, green vegetables, and yellow vegetables) among couples was high. However shared dietary habits did not significantly affect the association of cancer incidence between spouses. Although concordance of smoking and alcohol intake was low, association of cancer risk was stronger when the couple shared smoking and drinking habits.

Spouses also often share risk factors for cardiovascular disease such as smoking habits and high blood pressure, body mass index, and total and low-density lipoprotein (LDL) cholesterol levels (Di Castelnuovo et al., 2009). A cross-sectional analysis of 66,130 married couples in Shanghai found significant husband-wife associations for heart disease, high blood pressure and stroke (Jurj et al., 2006). Another cross-sectional study of 8386 married couples from the United Kingdom also found similar patterns for husband-wife associations, but only the association for high blood pressure was significant (Hippisley-Cox et al., 2002). The authors of the two latter studies suggested these associations could reflect shared dietary patterns, but no dietary intake data was collected.

Both genetics and environment contribute to disease incidence. Spousal studies suggest that lifestyle factors shared by spouses, i.e., tobacco and alcohol use, may lead to shared risks for some types of cancer, for example lung and tongue, and for heart disease and high blood pressure. However the role of diet is not clear, as most studies did not assess dietary intake. The one study that examined dietary habits based on frequency but not amount of intake found no significant effect on association of cancer incidence among the couples (Izumi et al., 2004). Further research is needed to determine whether spouses' shared dietary habits influence disease risk.

Cancer and Heart Disease Prevalence among Low-Income Populations

According to Healthy People 2010 (US Department of Health and Human Services, 2000), low-income individuals suffer from more chronic diseases compared to their higher income counterparts. For example, survival of common cancers is consistently lower among patients with lower socioeconomic status (SES) (Anderson, 1999; Bradley et al., 2001; Cross et al., 2002; Kogevinas & Porta, 1997; Rapiti et al., 2009; Yabroff & Gordis, 2003). This may be due in part to lower SES individuals more often presenting with advanced stage prostate, colon, and breast cancers compared to affluent individuals (Liu et al., 2001; Macleod et al., 2000; Menck & Mills, 2001; Rapiti et al., 2009; Schwartz et al., 2003) or because they receive less aggressive treatment for these cancers (Byers et al., 2008). For example, lower SES men with prostate cancer are less likely to receive curative treatment (surgery or radiotherapy) and instead more likely to be managed by watchful waiting (Rapiti et al. 2009). For women, another underlying factor may be that low-income breast cancer patients are more likely to present with estrogen-receptor (ER) negative tumors, which typically have a worse prognosis than ER positive tumors (Gordon, 1995; Thompson et al., 2001). Thompson et al. (2001) report that although a difference in prevalence of breast cancer tumor type exists between low-income and affluent women, it is not great enough to indicate that ER status is the sole reason for differences in survival. "Comorbidity, immunological competence and nutrition" (pg. 314) may be underlying factors for the disparity in prognosis between these two groups of women.

Death from cancer is more prevalent among lower SES inhabitants of the Appalachia region. This region, which includes Central Pennsylvania, encompasses 406 counties in 13 states from Mississippi to New York (CDC, 2002). The majority of these counties are rural, in which inhabitants tend to be older, low-income and less educated (Friedell et al., 1998). Researchers from the University of Kentucky and Penn State University, in cooperation with the Centers for Disease Control and Prevention, looked at the cancer death rates of the Appalachia region between 1994-1998 (CDC, 2002). They focused on cancers of the lung, colon-rectum, female breast and cervix, and male prostate. Compared to the national average, they found that the Appalachia region had an elevated death rate for all cancers studied - particularly in the rural areas. The authors report that the Appalachia region has more risk factors for cancer that include tobacco use, physical inactivity, and poor accessibility to health care (CDC, 2002).

Morbidity and mortality from cardiovascular disease (CVD; which encompasses heart disease) is also inversely related to socioeconomic status (Cabrera et al., 2001; Iribarren et al., 1997; Tyroler, 1999; Yu et al., 2000). Although recently there has been a decline in CVD among higher socioeconomic individuals, a similar trend is not evident among lower socioeconomic individuals. The gap between socioeconomic classes in CVD occurrence and mortality is widening (Bartley et al., 2000; Jemal et al., 2008; Kaplan & Keil, 1993), perhaps because activities for reducing CVD risk have had more impact on those with higher SES (Bartley et al., 2000; Brannstrom et al., 1993). Lenfant (1996) presents several potential reasons for higher CVD prevalence among those with lower SES including less favorable: 1) health behaviors (i.e., smoking, poor diet, physical inactivity); 2) biological factors (i.e., high blood pressure, high serum cholesterol, diabetes and adiposity), 3) psychosocial factors (i.e., weak social support, job insecurity, unemployment), and 4) environmental conditions (i.e., access to and use of medical services). As with cancer, the Appalachian region has higher rates of morbidity and mortality from heart disease compared to the rest of the nation (CDC, 1998; Halverson et al., 2002; Schwartz et al., 2009).

In summary, low-income individuals are at an increased risk of acquiring and/or dying of cancer and cardiovascular disease. Therefore, methods of reducing the risk of developing these diseases need to be developed and tested among this population.

Fruit and Vegetable Intake in the US

The recommended dietary pattern to reduce the risk of cancer includes a high consumption of fruits and vegetables (Kushi et al., 2006; National Cancer Institute, 1995; US Department of Health and Human Services, 2000). The National Cancer Institute (NCI) and the Produce for Better Health Foundation implemented the “5-A-Day for Better Health Program” in 1991 to encourage Americans to eat at least 5 servings of fruits and vegetables every day. A baseline survey in 1991 (Subar et al., 1995) found that American adults were consuming an average of 3.8 daily servings of fruits and vegetables. Less than one-quarter (23.4%) of adults were consuming 5 or more daily servings.

Stables et al. (2002) conducted a follow-up survey in 1997. When the data was adjusted for demographic shifts, the increase in mean daily fruit and vegetable consumption between 1991 and 1997 (3.8 to 3.9 daily servings) was not significant (p=0.12), and the mean daily intake still fell a full serving below the recommended 5-A-Day goal. However, model-adjusted analyses did show a small but significant increase between 1991 and 1997 in the percentage of adults consuming 5 or more servings daily (23.4% to 25.8%). Additionally, the percentage of adults in the lowest income bracket consuming 5 or more servings daily increased significantly in 1997 (20.7% to 29.1%). Adjusted analyses also showed that awareness of the need to eat 5 or more daily servings increased significantly (7.7% to 19.2%), as did awareness of the 5-A-Day program (2.0% to 17.8%). The biggest contributor to the increase in fruit and vegetable consumption in the follow-up survey was higher fruit consumption, a pattern noted in other studies (Ammerman et al., 2001; Trudeau et al., 1998).

More recently, using data from the National Health and Nutrition Examination Survey (NHANES III and NHANES 1999-2000), Casagrande et al. (2007) found American adults *decreased* their vegetable consumption between 1988-1994 and 1999-2002. Only 32% of adults met vegetable recommendations (at least three daily servings) in 1999-2002, which was significantly less than in 1988-1994 (35%). Only 11% of adults were meeting guidelines for both fruits (at least two daily servings) and vegetables in both data sets. Low-income individuals were less likely to meet the recommendations in both data sets, and the authors suggested that future interventions target low socioeconomic groups.

Comparable percentages of adults meeting recommendations were found in the recently released report on fruit and vegetable intake by state, based on the 2007 Behavioral Risk Factor Surveillance System (CDC, 2009). No state met daily recommended fruit or vegetable consumption (at least two or three servings, respectively). In Pennsylvania, 35% of adults met fruit recommendations, 27% met vegetable recommendations, and 15% met guidelines for both fruits and vegetables.

In 2005, the US Department of Agriculture's (USDA) increased recommendations for fruit and vegetable intake beyond '5-A-Day.' The current food guide, called MyPyramid, provides recommendations for fruit and vegetable intake that depend on caloric needs (based on age, sex and physical activity level), with specific recommendations given for sub-groups of fruits and vegetables (i.e., dark green, orange) (USDA). Depending on age and sex, sedentary adults are now encouraged to eat a total of 3.5 to 5 cups of fruits and vegetables a day (5 to 6.5 cups if physically active) (USDA).

Kimmons et al. (2009) used data from NHANES 2003-2004 and found that less than 10% of Americans (adolescents and adults) met their calorie specific MyPyramid fruit or vegetable recommendations. Among adults, the largest contributors to vegetable intake were fried and non-fried potatoes, lettuce, and tomatoes and tomato products (pizza, pasta sauces, and salsa). Few adults met recommended intakes of the dark green (9% men; 12% women) and orange (7% men; 9% women) vegetables specifically. Recommended intakes of these vegetables for adults range from 2 to 3 cups/week of dark green vegetables and 1.5 to 2.5 cups/week of orange vegetables, depending on caloric needs (USDA). Low adult intake, approximately 0.2 daily ½-cup servings, has also been reported for each of the orange, cruciferous and dark green vegetable groups using data from NHANES 1999-2000 and/or Continuing Survey of Food Intakes by Individuals (CSFII) 1994-1996 (Guenther et al., 2006; Johnston et al., 2000). The deep orange, cruciferous and dark green leafy vegetables contain both nutrients and phytochemicals that may be especially protective against chronic disease such as cancer and heart disease (Van Duyn & Pivonka, 2000).

Interventions Conducted to Increase Fruit and Vegetable Intake

In 1993, NCI funded nine community intervention studies to assess the effectiveness of the 5-A-Day program. Four interventions were based in schools (Baranowski et al., 2000; Nicklas et al., 1998; Perry et al., 1998; Reynolds et al., 2000), one targeted women in Women, Infants, and Children (WIC) program sites (Havas et al., 1998), three were worksite-based (Beresford et al., 2001; Buller et al., 1999; Sorensen et al., 1999), and one targeted rural African Americans in North Carolina black churches (Campbell et al., 1999). All of these interventions resulted in positives changes in fruit *and* vegetable consumption. Significant ($P<.05$) increases ranged from 0.2 to 1.7 daily servings. Two of these interventions specifically targeted low-income audiences (Buller et al., 1999; Havas et al., 1998). These two plus six other interventions to increase fruit and vegetable consumption among low-income audiences are described in more detail below. Also discussed are interventions conducted in black churches, including the intervention reported by Campbell et al. (1999) mentioned above.

Interventions among Low-Income Audiences

National strategies to increase fruit and vegetable consumption include mass media messages, point-of-purchase promotions and product labeling. Efforts such as these often do not reach low-income populations (Buller et al., 1999), posing a challenge for educators. Low-income people cite many barriers to making dietary changes (Hampson et al., 2009; Hartman et al., 1994; John & Ziebland, 2004; Maclellan et al., 2004; McGee et al., 2008; Reicks et al., 1994; Treiman et al., 1996). These include family members' food preferences, lack of availability of and familiarity with healthful foods, extra time, effort, and money necessary for buying and preparing healthful foods, lack of preparation and cooking skills, personal dislike of healthful foods or preference for other foods, and lack of knowledge about healthful foods.

Among the nutrition-related intervention projects designed to increase fruit and vegetable consumption conducted among low-income populations, one was carried out over a 2-year period by researchers at the University of Maryland. They evaluated a 5-A-Day Program offered to low-income women enrolled in WIC using peer educators through a randomized crossover design (Havas et al., 1998). Intervention participants moved to higher stages-of-change and increased knowledge, attitudes, and self-efficacy. Additionally, the program increased mean fruit and vegetable consumption by 0.4 daily servings among program participants versus controls.

These researchers later investigated the effectiveness of a different program, the Maryland WIC Food for Life Program, which was aimed at reducing cancer risk by modifying multiple dietary factors (Havas et al., 2003). This randomized intervention, which also utilized peer educators, focused on increasing fruit and vegetable consumption, as well as increasing fiber intake and decreasing percent of calories from fat. Compared to controls, program participants decreased their calories from fat by 1.6%, increased fruit and vegetable consumption by 0.4 servings/day, and increased fiber consumption by 1.0 gram/per day at two months post-intervention assessment. These changes were greater than those in similar trials conducted previously with populations of higher socioeconomic status. Neither of the above studies (Havas et al., 1998; Havas et al., 2003) reported fruit and vegetable intake separately. The small increase in total number of daily servings may have been due to higher fruit intake with virtually no change in vegetable intake, as found in other studies (Ammerman et al., 2001; Stables et al., 2002; Trudeau et al., 1998).

Buller et al. (1999) investigated the effectiveness of a 5-A-Day for Better Health worksite peer education program to increase fruit and vegetable consumption among low-income, multicultural adult employees. Informal social networks, or cliques, were identified and pair-matched based on several factors including total daily consumption of fruits and vegetables, stage-of-readiness-to-increase fruit and vegetable consumption, and various demographic characteristics. Within each pair, one clique was randomly assigned to the intervention group that received a non-peer-based General 5-A-Day Program for the first 9 months and then received the General 5-A-Day Program plus the 5-A-Day Peer Education Program for the last 9 months. The other clique from each pair concurrently served as a control clique, which received the non-peer-based General 5-A-Day Program for all 18 months. The General 5-A-Day Program used standard communication channels such as workplace mail, posters, cafeteria promotions, and speakers. The peer-based program used peer educators, one chosen from each clique, who were trained to spend about two hours per week talking about fruits and vegetables with their co-workers and also handed out print material. A total of 41 control cliques with 332 employees and 41 intervention cliques with 363 employees completed the program. Fruit and vegetable intake assessments were made at baseline, the end of the 18-month program (outcome), and at a 6-month follow-up. Significant effects of the peer education program were seen at outcome. Intake of fruits and vegetables increased by 0.77 daily servings ($p<.0001$) based on 24-hour diet recall data and this increase persisted at 6 months, although intake was lower (increase of 0.41 daily servings compared to baseline; $p = .034$). Increase in fruit intake had the biggest impact on the initial increase in total daily servings of fruits and vegetables. However, at the 6-month follow-up the increase in fruit intake had essentially disappeared, while the increase in vegetable intake persisted.

Efforts have also been made to increase fruit and vegetable intake of WIC participants through farmer’s markets, with varying levels of success. Anderson et al. (2001a) assigned women from WIC and Community Action Agencies to one of four groups: education only, coupons only, education and coupons, or no intervention. Coupons, but not education alone, increased fruit and vegetable consumption marginally and coupons alone actually appeared to lower intake of six targeted types of fruits and vegetables. In a cross-sectional survey, Kropf et al. (2007) found that WIC participants in the Farmers' Market Nutrition Program group had significantly higher vegetable intake (2.2$\pm$1.2 servings/day) than women participating in WIC only (1.9$\pm$1.00 servings/day). There were no significant differences between the groups in other fruit and vegetable behaviors. It is possible that women with greater previous vegetable intake may have self-selected into the Farmers' Market Program. A study by Anliker et al. (1992) found no significant effect of farmer's market coupons on WIC participants' overall fruit and vegetable intake. Overall these three studies indicate that just providing coupons for farmer's markets is not likely to substantially increase intake of fruits and vegetables.

The Sisters in Health program targeted fruit and vegetable intake among low-income women (Devine et al., 2005). Experimental group participants attended a series of 90-minute lessons (one per week for 6 weeks) facilitated by a paraprofessional while control group participants received parenting or budgeting programs (it is not clear whether controls were given a choice of program). Gain in combined fruit and vegetable intake was significantly greater in the experimental versus control group (1.6$\pm$0.2 versus 0.8$\pm$0.3 times per day) at follow-up. However, most of this difference was due to improved fruit and juice consumption among experimentals while there was no significant difference in frequency of vegetable intake between treatments.

Shankar et al. (2006) evaluated an intervention to increase fruit and vegetable intake among women aged 20-50 residing in Washington, DC housing communities. Participants were to attend seven 90-minute sessions (six formal sessions that were held twice weekly for 3 weeks, plus one 'booster' session held 6 weeks later - between post-test and 4-month follow-up). There was no control group. In addition to nutrition education and skill development (i.e., menu planning, budgeting, shopping, meal preparation), the intervention included discussions on how to get family members involved with making dietary change and provided laminated place mats with key messages from each session designed to help participants educate family members at mealtimes and create family support for change. Intake was assessed by three 24-hour recalls for each subject at each time point (baseline, post-test and 4-month follow-up). There was no significant improvement in fruit and vegetable intake between baseline (3.05 servings of fruits and vegetables) and post-test (3.22 servings) or follow-up (2.83 servings).

Overall, these interventions, which ranged from providing just coupons to offering programs lasting up to 18 months, produced at most 0.8 serving/day change in fruits and vegetables and in some cases the change was mainly due to fruit intake. Altering vegetable intake proved extremely difficult.

Interventions in Black Churches

Interventions have also targeted black churches. Campbell et al. (1999) reported results from the North Carolina Black Churches United for Better Health Project, one of the nine NCI funded projects to evaluate the 5-A-Day program. Intervention participants increased their fruit and vegetable intake by 0.85 servings/day compared to the control group at the 2-year follow-up. Most of this increase came from increased fruit (0.66 servings/day) as opposed to vegetable intake (0.19 servings/day).

Resnicow et al. (2001) evaluated the Eat for Life (EFL) trial. Black churches were randomly assigned to one of three treatments: control (received standard nutrition education materials), a culturally sensitive multi-component self-help intervention (SH), or SH plus motivational interviewing (MI). MI involves client-centered phone calls that help the client proceed through ambivalence about change and allow the counselor to tailor the content and format. Counselors use an encouraging and non-confrontational tone to help the client overcome problems as opposed to providing information or advice not requested by the client. The SH + MI group made significantly greater improvements in fruit and vegetable intake compared to the other two groups, with a net improvement over the control group of 1.12 servings/day (mean of 3 food frequency questionnaires (FFQs)). They also found that vegetable intake specifically was significantly improved in the SH + MI group, with a net increase over the control group of 0.5 servings/day (mean of 3 FFQs). Resnicow et al. (2004) later evaluated the Body and Soul program, which encompassed components from both EFL (including MI) and the Black Churches United for Better Health project described above. They found improvements in fruit and vegetable intake similar to that seen in the EFL study. The net fruit and vegetable increases in the intervention group versus controls was 0.7 and 1.4 servings/day based on the 2-item and 17-item intake measures, respectively. Net increases of vegetable intake were 0.2 and 0.5 servings/day for the 2-item and 17-item measures, respectively. Resnicow et al. (2005) evaluated the Healthy Body Healthy Spirit intervention, designed to improve fruit and vegetable intake as well as physical activity, again incorporating MI. Black churches were assigned to one of the same three treatments groups as in the EFL study (control, SH, SH + MI). Both the SH + MI group, and to a lesser extent the SH group, made significant improvements in fruit and vegetable consumption that were similar to, but slightly smaller than in the EFL study. Increases in fruit and vegetable intake were 1.13 servings/day for the SH + MI group, 0.44 servings/day for the SH group, and 0.17 servings/day for the control group.

Despite lengthy contact with participants and considerable time and effort on the part of educators, the above interventions in Black churches resulted in very modest improvements of about one serving per day of fruit and vegetable intake with at most a half serving per day increase in vegetable intake.

All the interventions reviewed targeted individuals, assuming they could manage a change in fruit and vegetable intake irrespective of their social living situation. The one study that did attempt to address family barriers produced no change in intake. The modest effectiveness of these interventions may reflect lack of consideration for and of strategies to alter family member influence or ignoring issues of availability and time and effort needed to make changes. These studies focused on individuals who may or may not have been gatekeepers to the family diet, but did not attempt to involve other family members. Further research is needed to fully understand the internal family factors that influence vegetable consumption so that more appropriate nutrition interventions can be designed that affect the family unit as a whole. Since fruit intake appears easier to increase than vegetable intake, future nutrition interventions should focus on increasing vegetable consumption specifically, rather than providing a general fruits and vegetables message (Stables et al., 2002; Trudeau et al., 1998).

Intra-Family Influences on Food Choices

Most studies on food choice behavior concentrate on characteristics of the individual such as age, sex, education level, socioeconomic status, marital status and personal attitudes and beliefs, which are all thought to influence food choice. However, family members also have a large impact on food choices, and their preferences are often barriers to introduction of healthful foods to the family (Bradbard et al., 1997; Hampson et al., 2009; Hartman et al., 1994; Krummel et al., 2002; Maclellan et al., 2004; McGee et al., 2008; Schafer et al., 1995).

Women traditionally do most of the meal planning, shopping, and preparation and are seen as the “gatekeepers” of the family diet (De Bourdeaudhuij, 1997; Harnack et al. 1998; Lewin, 1943). But the influence of family members on food choice decisions cannot be ignored.

Numerous studies show that the food preferences of the husband determine what foods are served at family meals (De Bourdeaudhuij, 1997; DeVault, 1987; Eppright et al., 1969; Jansson, 1995; Kerr & Charles, 1986; Pill & Parry, 1989; Brown & Miller, 2002). This is especially true when the husband has strong food preferences (Brown & Miller, 2002). In turn, women may serve fewer foods they prefer such as casseroles, certain vegetables, or pasta, and serve more foods that their husbands prefer such as meat and potatoes (Brown & Miller, 2002). This may result in the consumption of less healthful family meals since men are generally less concerned with eating healthful foods (Fagerli & Wandel, 1999; Lawlor et al., 2001; Steptoe et al., 2002; Wardle & Griffith, 2001) compared to women, who are more likely to attempt to comply with current dietary recommendations (Dynesen et al., 2003; Fagerli & Wandel, 1999; Sweeting et al., 1994).

Husbands' diets may improve slightly when their wives are enrolled in a low-fat dietary intervention (Shattuck et al., 1992; White et al., 1991), suggesting that women can have some influence on family food choices. Furthermore, not all wives are highly supportive of their husbands' dietary modifications. Bovbjerg et al. (1995) investigated the influence of spousal support on a low-fat dietary intervention for hyper-cholesterolemic men and found that some wives were only minimally supportive of the husbands' lipid-lowering diets. Variation in support levels among wives may be due to differing levels of commitment or risk perception. Assuming the wives were similar in age to their husbands, whose average age was 47 years, some of them may not have felt they were personally at risk yet. Women historically develop cardiovascular disease later in life than men, with risk increasing in the postmenopausal period (Mercuro et al., 2010).

Children also influence family food choices (Beagan & Chapman, 2004; DeVault, 1987; Kerr & Charles, 1986; Pill & Parry, 1989; Stratton & Bromley, 1999). A quantitative study of family quartets (two parents and two adolescents) found that children's food preferences can dominate some food choices in the family, as assessed through questions about family member influence on food choice decision-making that were completed by all four family members. When new foods are tried or suggested, the amount of influence each family member had depended on the type of food being considered. Husbands followed by children had the most influence on the introduction of reduced fat foods and children had the most influence on efforts to reduce candy and soft drink intake. Food choices were less healthful in households where children had more decision-making influence (De Bourdeaudhuij & Van Oost, 1998).

Although nutrition interventions traditionally target the female gatekeeper these studies indicate her ability to influence family food choices is limited by preferences of other family members. More research is needed to understand how, why and through what processes family members can influence vegetable choices for family meals in order to increase the gatekeeper's ability to introduce new vegetables into family meals.

Influence of Gender Role Expectations on Decision Making about Foods Served at Shared Family Meals (Family Power Hierarchy)

Power is defined as "the potential ability of one partner to influence the other's behavior" (Blood & Wolfe, 1960, p. 11), in this case, food choice decisions. The husband's influence on food choices at family meals is considered a reflection of his overall decision making power within the marriage (Blood & Wolfe, 1960; Charles & Kerr, 1988; Pill & Parry, 1989). Factors proposed to influence power include resources such as education level, income and occupational status (Blood & Wolfe, 1960). These tangible resources seemed reasonable when men were the breadwinners while women stayed at home to tend to the children and the house. Thus, women who brought fewer such resources to the marriage would have less decision making power.

However, husbands seem to have more leverage over food choice decisions, independent of the occupational status or work situation of either husband or wife (De Bourdeaudhuij, 1997). Likewise, Tichenor (1999) found that wives who had higher occupational status and income than their husbands did not display more power in the marriage. Rather, power was due to the partners' *gender role identities* (i.e., refer to the roles husbands and wives attempt to fulfill in the family as ingrained by social norms). The wives backed away from any additional power that they would have accrued from their economic contributions and instead opted to do things that appeared to give their husbands more power, thus strengthening their roles as "women" or "wives." For example, some couples kept separate bank accounts so that each partner could contribute to paying the bills and were not reminded each month of the amount of money in the other's account. Thus, decision making power is due to more than just tangible resources.

Thompson and Walker (1989) argued that women are simply reared to take on traditional feminine roles in marriage, one aspect of which would be to yield to their husband's food preferences. In interviews with 200 women with children, Charles & Kerr (1988) found that husband dominance in food choices was instilled in children at a very young age. Wives would cook "proper" meals (consisting of meat, potatoes and vegetables) when the husband was home. But if the husband was away, she would allow her children to choose a "snack-type" meal such as a sandwich or eggs. In other words, the eating pattern of the family reflected the preferences of the father when he was present and the preferences of the children when the father was not present. This concept was reinforced in a more recent study finding that some women still felt that providing a "proper meal" was important, incorporating into meals foods that please their husbands' preferences before those of themselves or their children (Brown & Miller, 2002). When these children mature and have families of their own, they will likely take this pattern of father's dominance for granted. Further, Blood & Wolfe (1960) discuss the resource theory, which says that if someone is raised in a husband-dominant household, they will grow up to reproduce that balance of power (and may even believe that it is right) in their own relationships. In this case, the husband's dominance becomes an accepted norm, that if often not questioned.

Thus, husbands can have more decision making power in heterosexual relationships. This is more likely due to the gender role identities of each partner, rather than tangible resources, and this power is likely to influence what foods are served at meals.

Study Rationale, Hypotheses, Dietary Intake Assessment and Theoretical Models

Study Rationale

Vegetable consumption is associated with numerous health benefits. However, low-income Americans particularly are not consuming the recommended number of fruit and vegetable servings each day (Casagrande et al., 2007). Interventions designed to increase fruit and vegetable consumption have been only marginally successful despite huge investments of time and resources. Any increase in consumption is often due to higher fruit intake as opposed to higher vegetable intake. Therefore, a nutrition intervention that focuses on increasing vegetable consumption specifically, particularly for the deep orange, cruciferous and dark green leafy vegetables, is needed.

Family members affect food choices that are served at shared family meals, and may present a barrier to women who would like to introduce new foods to the family. Women typically do the food chores and are considered the gatekeepers to family meals (De Bourdeaudhuij, 1997; Harnack, et al., 1998; Lewin 1943), but the food preferences of the husbands and children appear to have the most influence on foods served at family meals. However, there are currently no documented methods to successfully engage the husband and children in considering new vegetable choices at family meals. For these reasons, this study gathered data on the intra-family factors that influence vegetable consumption within low-income, rural families, and using this data, identified and evaluated a strategy for introducing vegetables at family meals that would increase acceptance by family members.

This study was conducted in two steps. The first step used focus groups to characterize the process of family vegetable selection among a sample of low-income, rural Appalachian married or cohabiting men and women (the target population).The focus group discussion examined use and reactions to vegetables from the deep orange, cruciferous and dark green leafy families (i.e., our target vegetables). Differences between vegetable-likers and dislikers and between men and women were examined. Exchange Theory was used in this data analysis.

The second step was to design and pilot test a community-based wellness intervention for food preparers and their partners from among the target population. The intervention was based on Social Cognitive Theory and focused on increasing intake and serving of the target vegetables at family meals, with controlling portion size, choosing low-energy-density foods and increasing physical activity also discussed. So weight control through low-energy-density food choices, of which vegetables are one, was an underlying message in the intervention. Because the focus groups indicated a lack of familiarity with and acceptance of the target vegetables, and a need to taste new vegetables before introducing them into family meals, the program was presented as a supper club where participants were provided with ingredients and recipes they prepared as a group so that each took completed dishes home to their families to try. Food preparers were randomly assigned to either the experimental or control treatment. Experimental food preparers attended 8 weekly meetings, at which they prepared the recipes, while controls were mailed 8 weekly packets that included the same print recipes and handouts received by experimentals. Quantitative measures (questionnaires) were used to establish baseline variables and then to evaluate the intervention immediately and 3 months post-intervention. Couple interviews, guided by a reciprocal determinism model, were also conducted at baseline and immediately post-intervention to further explore participant experiences with the intervention. Evaluation data was collected from both the food preparer and his/her partner.

Nutrition Education Intervention Hypotheses (second step)

Based on this design, the hypotheses examined included -

A. In comparing trained i.e., experimental (E) versus control (C) food preparers and their partners:

H1. Intake of some target vegetables will be significantly increased in both E food preparers and their partners compared to C food preparers and their partners at post-intervention assessments.

H2. Reported frequency of serving of some target vegetables at family meals will be significantly increased in both E food preparers and their partners compared to C food preparers and their partners at post-intervention assessments.

H3. Mean liking scores of target vegetables will be significantly increased in both E food preparers and their partners compared to C food preparers and their partners at post-intervention assessments.

H4: Perceived disease risk scores will be significantly increased in both E food preparers and their partners compared to C food preparers and their partners at post-intervention assessments.

H5. Stage-of-readiness-to-eat more vegetables will be significantly increased in both E food preparers and their partners compared to C food preparers and their partners at post-intervention assessments.

B. In comparing trained (E) versus control (C) food preparers (not their partners):

H6: Intake of fiber, vitamins A and C, carotene and lutein will be significantly increased in E compared to C at 3-month follow-up.

H7: Self-efficacy (SE) scores will be significantly increased in E compared to C at post-intervention assessments.

H8: Daily step equivalents will be significantly increased in E compared to C at post-intervention assessments.

Dietary Intake Assessment

Assessing specific vegetable intake (and the accompanying nutrients) is a challenge. The usual instruments used to assess dietary intake are food records, 24-hour recalls and food frequency questionnaires (FFQs), each having strengths and weaknesses. Food records require subjects to record the types and amounts of foods and beverages, theoretically as they are consumed, for a period of usually 3 or 4 days. Food records can potentially provide very accurate information, as they do not rely on the subject’s memory. However, it can lead to underreporting because some subjects may simply not record everything eaten and other subjects may actually eat less (and eat different foods) as a result of the recording process itself. Food records also are a substantial subject burden, can encourage non-representative samples (subjects need to be motivated and literate), and can require high personnel costs because they are burdensome to code (Thompson & Subar, 2008).

In a 24-hour recall, the subject is asked to report all food and beverages consumed within the previous 24 hours or the previous day. It must be conducted by a well-trained interviewer, either in person or over the telephone, and can take 30 to 45 minutes to complete if the multiple pass approach (MPA) is used. This MPA includes a quick listing of foods eaten, prompting for foods that may have been forgotten, listing time and eating occasion, a detailed pass that provides more information about foods and their portion sizes, and a final review. There are many advantages of the 24-hour recall: it is not likely to change food intake behavior, subjects can generally remember most of what they've consumed, and it can result in a relatively representative sample because respondent burden is fairly low and it does not require literacy. Weaknesses of 24-hour recalls include underreporting of intake, the requirement of more than one day to capture usual intake, likelihood of missing infrequently eaten foods, and the high cost of staff time (Thompson & Subar, 2008).

A FFQ is a print or electronically administered instrument that includes a list of foods on which subjects indicate their usual frequency of consumption, and often portion size, over a specified time period. The strengths of the FFQ approach are that it is unlikely to change eating behavior, response burden is usually low compared to multiple food records or 24-hour recalls, subject's usual intake can be estimated over a period of time, and investigator costs related to data collection and processing are lower than the two previously described methods (FFQs are usually self-administered and their structured format allows them to be scanned and processed using a database). The weaknesses include not allowing for collection of detailed information such as cooking methods or brand, not listing all possible foods, and often being cognitively difficult for the respondent to answer. Balancing FFQ length (longer equals more specificity) with time required for completion (longer equals more participant burden) (Thompson & Subar, 2008) is a research challenge.

Three commonly utilized FFQs include the Block (Block et al., 1986) and Willett (Willett et al., 1985) FFQs and the National Cancer Institute's Diet History Questionnaire (DHQ) (Subar et al., 2001). This study utilized the DHQ, which has been validated in the Eating at America's

Study (EATS). Men and women subjects in EATS first completed four 24-hour recalls (one in each season) over the course of a year. Then one randomly chosen group completed the DHQ and Block FFQ (one month apart) while another group completed the DHQ and Willett FFQ (one month apart). Investigators compared the performance of the DHQ to the other two FFQs through correlation coefficients. They also calculated correlations between each of the FFQs with "true intakes" estimated using the 24-hour recall results. They found the DHQ performed as well or better than the other two FFQs at assessing true dietary intakes (Subar et al., 2001). A later study using data from EATS found that the DHQ performed generally as well as four 24-hour recalls in estimating dietary carotenoid and tocopherol intake when compared with serum concentrations of carotenoids and tocopherols. In general, adjusting for BMI did not appreciably change the values or significance of serum-diet correlations (Dixon et al., 2006), suggesting the DHQ is appropriate to use with overweight individuals. In addition, the DHQ addressed our target vegetables more thoroughly than the other two FFQs.

Social approval bias, or the tendency to respond in a way consistent with expected norms, is a concern with any self-reported dietary assessment method. Miller et al. (2008) examined social approval bias in fruit and vegetable intake assessed by FFQs and 24-hour recalls. Intervention subjects were told they were part of a study on fruit and vegetable intake and received information promoting fruit and vegetable intake prior to assessment. Controls were told only that they were in a study assessing general nutritional intake and did *not* receive the information on fruits and vegetables. The researchers hypothesized that the recalls would be less prone to social approval bias because they rely on memory of only the past 24 hours (compared to FFQs, which rely on memory of usual intake over the past year). However, they found substantial bias in reported fruit and vegetable intake from both FFQs and 24-hour recalls among intervention versus control subjects. They suggested that researchers could reduce this bias by using more objective assessments of dietary behavior such as direct observation or biomarkers.

However, these objective assessments can be costly and are not always feasible. Direct observation requires either the presence of personnel to directly observe foods eaten or cameras/video cameras to record foods eaten. In either case, data can be very time-consuming to gather and costly to analyze. This process may be best suited for confined target populations such as children in schools or employees in worksites where many subjects could be observed at one meal (Miller et al., 2008). Biomarkers require participants to give biological specimens (thus subjects must be willing to provide samples and personnel must be paid for specimen collection and processing) and they may not be specific for the food(s) of interest. For example, serum β-carotene levels might be used to estimate deep orange vegetable intake but other foods also contribute β-carotene to the diet (i.e., cantaloupe, dark leafy greens) (Talegawkar et al., 2008). Serum carotenoid levels are also influenced by an individual's body fatness, gender, smoking status, alcohol consumption, plasma cholesterol levels, and supplement use as well as the food matrix in which the carotenoid is found (Mayne, 2003). For instance, fat increases carotenoid bioavailability, so carotenoids are more bioavailable from vegetables in salads topped with full-fat dressing as opposed to salads topped with fat-free dressing (Brown et al., 2004). Hence many factors other than deep orange vegetable intake can influence serum β-carotene levels. Researchers are just beginning to find biomarkers specific for types of vegetables, such as urinary dithiocarbamate as a biomarker for cruciferous vegetable intake (Thomson et al., 2007).

As mentioned above, FFQ length is an issue, with longer FFQs increasing participant burden. In response to the need for brief program evaluation tools, short questionnaires or screeners assessing only fruit and vegetable intake have been developed and evaluated (Greene et al., 2008; Kim & Holowaty, 2003; Peterson et al., 2008; Thompson et al., 2002). However, these screeners query intake of fruits and vegetables in general, and lack the specificity needed in this study for the target vegetables (deep orange, cruciferous, dark green leafy). A short vegetable intake questionnaire (VIA) was developed for this study that asked specifically about the target vegetables. The VIA was administered in conjunction with the DHQ (which includes comparable questions about the target vegetables), allowing comparison of results from the two instruments to assess whether the shorter VIA could be an adequate alternative to the DHQ.

Researchers must balance issues of cost, specificity, feasibility, and participant burden when choosing which method of dietary intake assessment to use in their study. This study used a validated FFQ in order to estimate dietary intake over a period of time while being relatively low in cost to process and analyze. We also developed and evaluated a shorter vegetable intake questionnaire specific for the target vegetables.

Theoretical Models Used

Exchange Theory

Exchange Theory was used as the framework for designing the focus group questions for step one. Exchange theory has been used to study relationship factors such as marital quality and stability within social groups (Lewis & Spanier, 1979; Scanzoni, 1972) and a simple Exchange Theory for social marketing has been applied in nutrition-related research (Amella, 1999; Snow & Benedict, 2003; Johnson et al., 2006). For example, Amella (1999) used a simplified version to study how the interaction between caregivers and nursing home residents influenced the amount of food residents ate. Exchange Theory as outlined in the field of family studies has not been used widely in nutrition-related research. However Garrett (2008) urged nutrition scientists to examine theory from other fields to improve their ability to answer research questions. Because this study was examining family meal preparation, which involves interaction between food preparer and other family members around food selection, Exchange Theory was chosen over theory that emphasizes individual traits (i.e. Theory of Planned Behavior) to examine why certain foods are served at family meals. Its constructs were more likely to explain outcomes of family interactions around food selection.

Exchange Theory is based on the concepts of rewards, costs, outcomes and comparison level (Sabatelli & Shehan, 1993). A reward is anything that is viewed as appealing to one's interests. It can also be anything that serves as positive reinforcement for a certain behavior. A cost is essentially the opposite of a reward and is anything that involves punishment or loss of rewards. Outcomes are the rewards minus the costs sustained. One would assume that the greater the outcomes, the more satisfied one would be in a particular situation. However, satisfaction is also influenced by previous experiences and expectations, components of comparison level. Comparison level is the standard against which individuals assess the rewards and costs of a situation and it is based on previous experiences and cultural norms (i.e., gender roles based on gender identities). In other words, an individual's experiences in a relationship will influence later exchanges in that relationship. See Figure 1-1 for an illustration of how these four concepts are interrelated.

This model may be used to understand why certain foods are served at family meals. For instance, how does the food provider decide whether to serve a green salad instead of corn at the evening meal? Costs include the negative reactions of the family members, time spent preparing a food that will not be eaten, or money spent on wasted food. Rewards include personal satisfaction and feeling good about serving more healthful food. Comparison level considers previous experiences where the family rejected or accepted new foods. It also takes into account the provider's ideal of a good meal that the family appreciates. The result is that if the provider expects the costs to exceed the rewards, there will be poor satisfaction and the contemplated food (i.e., green salad) will not be served at meals.

Several assumptions about humans are rooted in the Exchange Theory (Sabatelli & Shehan, 1993). For one, individuals are assumed to try to maximize rewards and minimize costs. Another assumption is that people are rational beings and as such calculate rewards and costs and consider alternative choices before making a decision. Because it is not always possible to predict the rewards and costs of a future situation, people also consider their expectations for rewards and costs when making decisions. When no alternative choices are attractive, they will choose the alternative with the least negative outcome. Additionally, the manner in which individuals weigh rewards and costs differs from one person to the next and can change over time. Likewise, the value that individuals give to another's behaviors in a relationship also varies among people and over time. Finally, the more the value of a reward surpasses someone's expectations, the less value that person will give the reward in the future.

Social Cognitive Theory and Reciprocal Determinism Model

The nutrition education lessons developed for the second step in this study are based on Social Cognitive Theory (SCT). SCT has several major concepts that can be applied in health behavior interventions including the effects of the physical environment (factors external to a person such as family members or foods available), the degree of social support, the situation (personal perception of the environment), personal expectations (anticipated results) and expectancies (whether results are desirable) of a behavior, behavioral capability, self-control, self-efficacy, observational learning, reinforcement of behaviors, emotional coping responses (strategies for dealing with emotional stimuli), and reciprocal determinism (Baranowski, 1997; Baranowski et al., 1997). Table 1-1 provides a list SCT constructs used in the design of this study's educational program, plus definitions and examples of application.

SCT has been used widely to explore dietary behavior (Ball et al., 2009; Beverly et al., 2008; McGee et al., 2008; Story et al., 2002) and frame the design of behavioral dietary interventions (Anderson et al., 2001b; Edmundson et al., 1996; Miller et al., 2002; Sorensen et al., 1999; Turner-McGrievy et al., 2009).

Reciprocal determinism proposes that a person's behavior both influences and is influenced by their environment and personal characteristics as seen in Figure 1-2 (Baranowski, 1997; Baranowski et al., 1997).

Baranowski and Hearn (1997) extended the reciprocal determinism concept from SCT to create a reciprocal determinism model relating personal and family characteristics to explain dietary behavior (see Figure 1-3). This model was used for the couple interviews evaluating food preparer and partner experiences in step two. Baranowski and Hearn postulate that every family member has personal characteristics regarding food including preferences, outcome expectations such as family member reactions, self-efficacy and skills. These personal characteristics reciprocally interact with family characteristics (mechanics of food production in the home, supportive behaviors, and family functioning) to influence dietary behavior. Mechanics of food production in the home (i.e., family food system) can be defined as an examination of what foods were purchased, grown in gardens or otherwise brought into the home, and how these foods were prepared. The second step intervention focused on the external (i.e., stores used) and internal food systems (i.e., foods purchased, family meals, vegetable gardens).

Family functioning describes family member interaction and closeness. The Circumplex Model of Marital and Family Systems (Olson & Gorall, 2003) describes three dimensions to family functioning: flexibility, cohesion and communication. The focus of this study was mostly on family flexibility, which describes the amount of change or variance allowed within a family's roles, rules and power structure. This can range from rigid (very low flexibility) to chaotic (very high flexibility). In the evaluative couple interviews, family functioning was examined through questions about food shopping and preparation *roles*, food *rules*, veto *power* and flexibility around vegetable choices. Although not specifically assessed in this study, cohesion describes a family's emotional bonding while communication facilitates flexibility and cohesion.

In summary, this study utilized Exchange Theory, Social Cognitive Theory, Baranowski and Hearn's reciprocal determinism model and the Circumplex Model of Marital and Family Systems. The use of these theories and models strengthened the design and evaluation of data in this study.

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Table 1-1. Social Cognitive Theory constructs, definitions, and examples of application (Baranowski, 1997; Baranowski et al., 1997)

Construct	**Definition**	**Examples of application**
Physical Environment	Factors external to a person	Increase the availability of vegetables in the home
Social support	Encouragement received from those close to an individual	Interact with program leader and small groups who get to know each other well at each lesson; encourage family members to taste dishes and provide feedback on them
Expectations	Anticipated behavioral results	Learn the nutritional value and health benefits of vegetables
Behavioral capability	Knowledge and skills necessary to execute a behavior	Gain knowledge on choosing, storing and preparing vegetables; develop skills to prepare vegetables in recipes
Self-efficacy	Self-confidence to enact a behavior	Gain confidence while discussing ways to introduce vegetables to the family and learning to prepare vegetables
Observational learning	Watching other's actions and resulting outcomes	Share ideas for introducing vegetables to the family; watch others fix vegetable dishes
Reinforcement	Positive or negative reactions to one's behavior that influence whether the behavior is repeated	Receive oral compliments on activities/recipe preparation and reinforcement of principles in subsequent meetings.

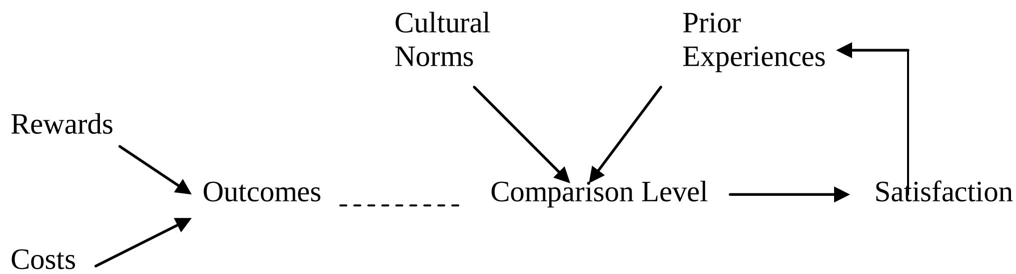

Figure 1-1. Exchange Theory model (Sabatelli & Shehan, 1993)

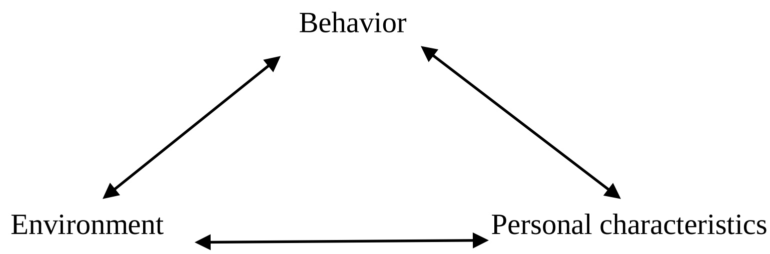

Figure 1-2. Reciprocal determinism model

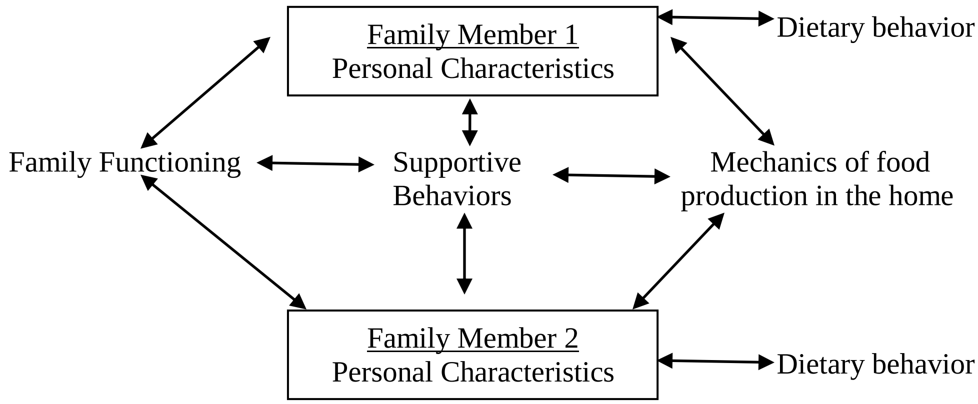

Figure 1-3. Baranowski and Hearn's (1997) model of reciprocal determinism relating family and individual characteristics

Chapter 2

Family members' influence on family meal vegetable choices[1]

Abstract

Objective**:** Characterize the process of family vegetable selection (especially cruciferous, deep orange, and dark green leafy vegetables); demonstrate the usefulness of Exchange Theory (how family norms and past experiences interact with rewards and costs) for interpreting the data.

Design**:** Eight focus groups, two with each segment (men/women vegetable-likers/dislikers based on a screening form). Participants completed a vegetable intake form.

Setting**:** Rural Appalachian Pennsylvania.

Participants**:** 61 low-income, married/cohabiting men (n=28) and women (n=33).

Analysis**:** Thematic analysis within Exchange Theory framework for qualitative data. Descriptive analysis, t-tests and chi-square tests for quantitative data.

Results**:** Exchange Theory proved useful for understanding that regardless of sex or vegetable-liker/disliker status, meal preparers see more costs than rewards to serving vegetables. Past experience plus expectations of food preparer role and of deference to family member preferences supported a family norm of serving only vegetables acceptable to everyone. Emphasized vegetables are largely ignored due to unfamiliarity; family norms prevented experimentation and learning through exposure.

Conclusions and Implications**:** Interventions to increase vegetable consumption of this audience could 1) alter family norms about vegetables served, 2) change perceptions of past experiences, 3) reduce social and personal costs of serving vegetables and 4) increase tangible and social rewards of serving vegetables.

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Introduction

In the US, Appalachia covers a mountainous, largely rural region crossing thirteen states whose residents suffer higher rates of mortality from chronic disease than residents in other regions (Halverson et al., 2004). Reflecting the region's cultural background, traditional Appalachian food is "unpretentious, solid, and filling" (Flasher, 1995). Meat and potatoes are a meal staple in this area, while vegetables appear less often in meals than they once did (Flasher, 1995). Central Pennsylvania, a part of Appalachia, is home to descendants of Irish, English, German and Eastern European settlers who favor this meal pattern.

The US Department of Agriculture recommends adults eat at least 7 to 10 (1/2 cup) servings of fruits and vegetables a day (US Department of Agriculture, Guenther et al., 2006). However, Americans consume fewer than the recommended servings (Casagrande et al., 2007; Guenther et al., 2006) and the low-income consume even fewer fruits and vegetables (Casagrande et al., 2007). Interventions to increase fruit and vegetable consumption have had limited success and often do not distinguish between intake of fruits and vegetables when reporting results (e.g., Anderson et al., 2001; Havas et al. 2003). Studies that report intake separately often find fruit contributes the most to any increase while vegetable intake is virtually unchanged (Devine et al., 2005; Stables et al., 2002). Other researchers have recommended that future nutrition interventions focus on increasing vegetable consumption (Stables et al., 2002), particularly cruciferous, deep orange and dark green leafy vegetables (Stables et al., 2002; Van Duyn & Pivonka, 2000) because their intake is consistently low (Guenther et al., 2006; Johnston et al., 2000), and they contain micronutrients that offer protection against chronic diseases (Van Duyn & Pivonka, 2000).

Most people eat vegetables at the evening meal (Satia et al., 2000). However, studies of European and urban US populations indicate both children's and husbands' food preferences often dictate what foods are served at family meals (Brown & Miller, 2002; Kerr & Charles, 1986; Stratton & Bromley, 1999). If the husband prefers few vegetables with meals, the wife may serve fewer vegetables rather than face his disapproval (Brown & Miller, 2002). There is little understanding of other factors that affect family member vegetable preferences and patterns, especially for low-income, rural US food preparers. An understanding of these factors is needed to develop a community-based, family-centered nutrition program featuring vegetables for the low-income, rural populations served by the Northern Appalachia Cancer Network, of which Pennsylvania is a partner (Kluhsman et al., 2006).

Exchange Theory from the family studies literature was used to guide the research because it includes constructs relevant to the interaction between the food preparer and other family members on food choice decisions. Exchange Theory is based on the constructs of norms, rewards, costs, comparison level, and outcomes. A reward serves as positive reinforcement for a certain behavior, while a cost involves punishment or loss of rewards. Comparison level is the standard against which individuals assess the rewards and costs of an action, based on previous experiences, and social norms or rules that govern a situation (Sabatelli & Shehan, 1993). An outcome reflects the balance of related costs, rewards, and comparison level. Exchange Theory is useful because it incorporates important factors identified in previous studies, such as personal persuasion (Bradbard et al., 1997; Brown & Miller, 2002; Kerr & Charles, 1986; Stratton & Bromley, 1999) and family member expectations (Brown & Miller, 2002). Although nutrition programs have used a simpler Exchange Theory for social marketing (Amella, 1999; Johnson et al., 2006; Snow & Benedict, 2003), family studies Exchange Theory has not been used extensively in nutrition-related research. Nutrition scientists are urged to examine theory from other fields to improve our ability to answer research questions (Garrett, 2008). Exchange Theory could illuminate outcomes of family interactions around food selection, something that is not well understood.

The authors hypothesized that the interaction of family norms and past experiences with rewards and costs would influence the vegetables served at a family meal. Our objectives were to: 1) characterize the process of family vegetable selection among a rural, low-income Appalachian population of married or cohabiting men and women and 2) demonstrate the usefulness of Exchange Theory for interpreting the data. Our specific interest was consumption of cruciferous, deep orange, and dark green leafy vegetables. We also examined differences between vegetable-likers and dislikers, not examined previously in the literature, and between men and women, rather than just women (e.g., Kerr & Charles, 1986; Reicks et al., 1994; Treiman et al., 1996) to the exclusion of men.

Methods

The Penn State University Institutional Review Board approved this research with an expedited review.

Participants

Potential participants were identified through community-based venues that provide assistance to low-income audiences (County Assistance and CareerLink offices, food pantries, etc.) in two rural Appalachian counties in Central Pennsylvania, both defined as rural by The Center for Rural Pennsylvania. Volunteer eligibility was based on the following inclusion criteria, gathered by a screening form: 1) gross annual household income no greater than $40,000, 2) married or cohabiting for at least one year, and 3) at least one partner age 40 years or older (an age when they may realize that diet affects their health). The screening form also included a list of 18 vegetables on which respondents indicated their degree of like/dislike on a 3-point scale: 15 vegetables from the cruciferous, deep orange and dark green leafy vegetable groups plus three ‘popular’ vegetables (corn, tomatoes, potatoes) that were included so vegetable-dislikers would not have to reject everything. Vegetable-likers were defined as those liking at least six out of the fifteen emphasized vegetables, while vegetable-dislikers became those liking five or fewer of these vegetables. The cutoff of six was based on an analysis of 60 initial screening forms that showed a distinct separation of vegetable-likers from dislikers. Focus groups were conducted separately with each of four segments - men/women and vegetable-likers/dislikers - to increase comfort sharing opinions and to examine differences between groups. Among those interested, 182 met the inclusion criteria. When time and location of each focus group was set, eligible persons living within a reasonable distance were invited to a focus group. When we had more recruits than needed for a particular group, we invited those recruited closest to the focus group date first because it was likely they were still interested and available. In all, 88 individuals agreed to participate and, of those, 61 attended (34% of those meeting inclusion criteria; 69% of those agreeing to participate).

Instruments

Participants filled out a demographic form and a 32-question vegetable intake form after securing written informed consent. The vegetable intake form was a validated NCI All-Day screener (Thompson et al., 2002) that has been used among low-income participants (Henry et al., 2006), which we revised. We replaced questions on the original screener about fruit, salad, beans and nonspecific vegetables with questions to assess intake during the previous month of our specific emphasized vegetable groups. We also added questions about a) number of family meals eaten together per week and how often our emphasized and other popular vegetables were served at family meals during the previous month, b) like/dislike of these vegetables and c) perceived cancer risk and the influence of vegetables thereon. To establish face validity and refine the instrument, questions underwent cognitive interview testing in December 2005 with six members of the target audience.

Focus Group Procedure

Scripted questions (Table 2-1) came from analysis of individual interviews with eight members of the target audience in 2004 who discussed their use of vegetables, particularly those we emphasized (Wenrich & Brown, 2007). The script was reviewed by psychology and communication faculty with focus group expertise. Eight focus groups (range=5 to 11 persons per group,) were conducted between January and July 2006, two with each segment: men/vegetable-likers (n=13); men/vegetable-dislikers (n=15); women/vegetable-likers (n=18); women/vegetable-dislikers (n=15). The 1.5-2 hour sessions were audiotaped and afterward, each participant received $20.

Analyses

Quantitative Data

Statistical analyses were conducted using SPSS (version 11.5 for windows, 2002, SPSS Inc, Chicago, IL). Descriptive statistics were calculated for demographic and vegetable-intake variables. Two-sided *t*-tests and chi-square tests were used to assess differences between groups for continuous variables and categorical variables, respectively. Cronbach's alpha assessed internal consistency of vegetable like/dislike scales. Statistical significance was set at $P<0.05$.

Qualitative Data

Focus groups were analyzed using principles outlined by Krueger (1994). Audiotapes were transcribed verbatim. One investigator reviewed the transcripts and developed a coding list of mutually exclusive categories that reflected the ideas emerging during responses to scripted questions that related to constructs of Exchange Theory (Figure 2-1). Each comment capturing a single idea pertinent to our objectives was considered a unique code. Codes were organized into sub-themes and two investigators independently coded the last two focus groups using the coding list. Inter-coder reliability was calculated on these two transcripts using Holsti's formula (Holsti, 1969). Reliability ranged from 82 to 84 percent. After each transcript was checked, differences were discussed and reconciled. One investigator then applied the revised coding scheme of 77 coding categories, to all group transcripts. Both investigators reviewed the coded transcripts, then wrote overall thematic summaries for each segment. Sub-themes were organized into major themes and then assigned to the relevant Exchange Theory construct. Results are presented by construct with coded responses mentioned in at least two focus groups reported for each sub-theme. Relevant quotes are included. Based on the analysis, we added an additional construct, strategies to get to positive outcomes, to the model.

Results

Participant Characteristics

Most participants (79%) were married, and there were no significant differences in household composition or other characteristics between the groups (Table 2-2) or between liker/disliker subgroups (data not shown). As shown in Table 2-3, vegetable-likers had significantly higher mean liking scores for cruciferous, deep orange and dark green leafy vegetables, as well as tomatoes, compared to dislikers. Vegetable-likers' intakes of cruciferous and deep orange vegetables were also significantly greater than that of dislikers, as was the frequency of serving cruciferous, deep orange and dark green leafy vegetables at family meals. Liker/disliker groups did not differ in their perceived cancer risk. Vegetable-likers were significantly more likely than dislikers to agree that the vegetables they eat are likely to affect their risk of developing cancer. Participants averaged 4.6 ± 2.3 family meals per week.

Norms (Family Meal Status Now)

Groups valued the traditional family meal and had similar definitions and food preparer expectations. Codes after quotations indicate quoted focus group: fg = focus group; m/w = men/women; l/d = vegetable-liker/disliker; 1/2 = first/second focus group within segment (i.e., fgml1 is the first focus group with men vegetable-likers).

Definition and Ideal Meals

Both men's and women's groups defined the family meal as those where everyone was present eating shared food and felt this was an important family activity: "We try to make it a point to gather at the evening meal so we can also discuss family problems or plusses" (fgml1). Family meals typically were evening events, but their location (living room versus dinner table), timing (set time or whenever ready) and frequency varied.

An ideal meal for most consisted of meat, potato/starch and sometimes a vegetable and/or dessert. For some, foods had to be filling and included items they raised in gardens: "Availability in the garden is a big thing" (fgwl2). Most men's groups expressed a preference for fresh venison and wild game: "I'm also a hunter and we don't buy anything in the meat line; we eat venison" (fgml1). Some women's groups indicated an ideal meal may include fruit and has to be foods everyone likes: "the family wanting the same thing, liking the same thing. Like if I say, 'What do you all want for dinner?' they'll say spaghetti. So I think that would be a good family meal" (fgwl1).

Roles and Responsibilities

The majority of the women and about half of the men were responsible for food preparation. Both men and women indicated the food preparer's responsibilities included making a variety of nutritious, well-balanced meals that family members like and can eat, timed to members' arrival home, and keeping work surfaces and foods clean (i.e. food safety). Pleasing everyone's food preferences was important: "…he taught me how to cook exactly the way he wants food, so it's perfect" (fgwd2). Women's groups emphasized being sensitive to everyone's likes and needs: “My mom’s diabetic, high blood pressure and stuff like that; so you have to make sure what you’re preparing isn’t going to hurt the person” (fgwd1). However, women vegetable-dislikers indicated a limited food budget restricted their ability to please everyone’s preferences: “My daughter wants pizza all the time. I’ll say, ‘Well, then you have to go out and earn money on your own if you want that kind of food’” (fgwd1).

Rewards

The social and practical rewards or positive reinforcements for serving meat and potatoes were much greater than for serving vegetables at family meals. Vegetable-liker/disliker status did not influence perceived rewards of *meat and potatoes*, but did influence rewards linked to *vegetables*.

Meat and Potatoes

All groups reported they and their families viewed meat as delicious, satisfying, and/or versatile. Although members of some families questioned meat-centered diets, all groups felt meat was the meal centerpiece: “Usually an American meal, you center it around meat.” (fgwd2). Women’s groups noted that meat was a good source of protein. All groups reported they and their families loved potatoes (a social reward), which were described as healthful (high in potassium), especially with skins on, and filling. Their most appreciated attribute was versatility. Both men and women described numerous ways, both traditional and unique, of fixing and serving potatoes: “make potato cakes with leftover mashed potatoes” (fgmd2).

Vegetables

In contrast, most rewards of vegetables expressed were personal benefits. Vegetable-likers personally felt that a major reward of consumption was their health benefits: “give you your vitamins” (fgwl1), “aren’t fattening” (fgwl1), and “can bring your blood pressure down” (fgml2). Men vegetable-likers commented on the various flavors of vegetables: “You don’t get the same taste from a cabbage as you do a cauliflower or celery” (fgml2). The forms available (fresh, frozen, canned) were another plus to both vegetable-likers and dislikers. Regardless if vegetable-liker or disliker, the most rewarding vegetables to serve were corn, peas and carrots, based on universal taste appeal and lack of negative family member comments. In six focus groups, sweetness was a key reason for liking these vegetables: “Corn because it’s sweet. It’s got a sweet taste to it” (fgmd2). Men stressed how vegetables became more acceptable if baked or cooked with meat so they absorb the meat flavor: “I never could eat [cooked carrots] and I don’t know why. Now, if you put it in a roast…I’ll eat it that way…it has the beef flavor going through it” (fgml1).

Costs

Serving meat and potatoes resulted in fewer social and practical costs than serving vegetables at family meals. Vegetable-liker/disliker status affected only perceptions of tangible costs of vegetables.

Meat and Potatoes

Some women's groups felt beef was expensive while some men's groups reported limiting meat due to prostate problems. In a men's and a women's group, some reported children were picky about choice of meat: "the only meat [my daughter] likes is chicken nuggets" (fgmd2). All women's groups and one men's recognized potatoes as starchy and potentially fattening and some women's group participants were eating fewer potatoes now: "I don't eat them all the time like I used to" (fgwd1). Vegetable-likers and dislikers did not differ in terms of *perceived* costs associated with meat and potatoes.

Vegetables

Some costs associated with vegetables were tangible and more often raised by vegetable-likers. Men's groups indicated that fresh vegetables were not always available while both groups noted that cheaper canned varieties could contain a lot of undesirable sodium. Members of all groups were unfamiliar with our emphasized vegetables when shown a list. They did not know how to prepare them so they tasted good. Also, some lived on tight budgets and "this stuff costs money and you don't want it to go to waste" (fgwd1). Lack of flexibility produces a routine: "you get in a rut with the same old vegetables - peas, carrots, beets and stuff" (fgml1).

For both vegetable-dislikers and likers, other costs were personal aversion based on taste (especially bitter flavors), smell (Brussels sprouts, spinach, mushrooms), texture (slimy or oozy okra, mushrooms or spinach; soft carrots) and appearance. A vegetable-disliker said, "[Some vegetables] taste yucky, some taste dull, and some don't have no taste at all" (fgwd2). Sometimes it just looked bad: "mushrooms to me look like dirt" (fgwd1). The social costs of ignoring key family member preferences prevented the food preparer from offering new vegetables at family meals. Regardless of vegetable-liker/disliker status, the influence of the husband and children was apparent: "I usually pick corn because that's about the only vegetable they eat." (fgwd1) Dislikers could block family access when they were either the preparer: "if I don't like it, I know they're not gonna like it because they're like me" (fgwd1) or partner: "I just tell her, 'You know what I like; do it'" (fgmd1).

Comparison Level

Past experience influenced choice of vegetables served at family meals and willingness to introduce new vegetables. Vegetable-liker status affected willingness to try new vegetables.

Vegetables Acceptable at Meals Now

Both men's and women's groups indicated family members disliked so many vegetables that only certain vegetables (corn, peas, carrots, string beans, and to some extent, broccoli and cauliflower) fixed specific ways were acceptable. Corn was the only universally acceptable vegetable. Women vegetable-likers listed a few more acceptable vegetables than dislikers. A few women vegetable-dislikers sometimes offered personally disliked vegetables at family meals: "[My daughter] wants to eat Brussels sprouts and she wants to eat this and that…so it's kind of like I force myself [to make vegetables]" (fgwd2). Most said there were no disagreements about vegetables at meals. Either choices avoid arguments: "if nobody likes it, I don't get it" (fgwd1), resistance is entrenched: "I have finally gotten him to the point where he will silently pick the vegetables out and push them off to the side" (fgwl2), or choices please the most powerful: "I ask her what she wants and that's what she gets" (fgmd1).

Reactions to New Vegetables

Participants in all groups indicated that some family members might try a new vegetable while others would not. One's willingness to try a new vegetable depended on their individual pickiness: "If it ain't creamed corn, it ain't whole kernel corn, or if it ain't on a cob, they're not doing it" (fgmd2), how the vegetable was prepared, how it looked: "[Canned kale] looks like something I would feed my dog" (fgwd2), and how unfamiliar it was to them. Generally, compared to vegetable-likers, vegetable-dislikers were less willing personally to try new vegetables. A man vegetable-disliker said "You'd be thrown out…If any one of them [emphasized vegetables] show up, this is my hand [sweeps hand across the table]" (fgmd1). In contrast, vegetable-likers were more positive: "My wife would ask what [the canned greens] were, but I would just tell her, 'Hey, let's try these tonight and see if we like it'" (fgml1).

Few participants reported having family rules about trying new foods. Some vegetable-dislikers would not pressure children to try anything 'new' based on their own negative childhood experiences. Despite being low-income, only some women indicated that family members had to eat what was served or "eat nothing else the rest of the night" (fgwd1). Discussion indicated these participants did not connect rules about trying foods to learning to like a variety of foods, perhaps because new foods were avoided.

Outcomes

Current vegetable choices for shared meals (outcomes) appeared to reflect the balance of costs, rewards, family norms and past experience.

Meal Patterns

The choice of foods, and vegetables particularly, for family meals was habitually based on an established pattern of dishes that family members liked and would eat: “After 28 years of marriage, she knows what I will eat and what I won’t eat” (fgmd1). Both men’s and women’s groups indicated choices reflected what the husband or children liked rather than the wife’s preferences: “a lot of vegetables I like he doesn’t, so we don’t have them” (fgwd1) and “I’m just glad my kids like a white, a green and an orange vegetable” (fgwl1). Sometimes two different dishes or meals were made to please conflicting tastes or vegetables might be omitted entirely. Both men and women reported always pairing certain vegetables with certain meats (i.e., green beans with ham). Availability (in season or on sale) also affected vegetable choices. Participants in both men’s and women’s groups would make vegetables for themselves that no one else ate: “she don’t like stewed tomatoes…So I’ll heat up a can of it, and then I just keep it to the side and I’ll just put it on my plate” (fgml2). Both men and women vegetable-dislikers indicated a family member’s absence from a meal allowed a food that person disliked to be served.

Freedom to Change Menus

Both men's and women's groups claimed that the food preparer had freedom to change family meal menus. But, based on the examples given, it was evident this was typically done from within what they knew everyone liked. They could change the menu to accommodate a missing ingredient or to make something quicker than what was planned, but choices were familiar and approved dishes. Others in both groups acknowledged that 'real change' was not contemplated or allowed because the food preparer had to make what family members wanted: "I couldn't go and make new dishes. I mean, I may make it one time and he would say, 'Don't make it again. I ate it this time. Don't expect me to eat it again.'…he's more of a meat and potato type person" (fgwl1). "She doesn't try. She's concerned about my health, but she knows she can't force me to eat anything" (fgmd1).

Strategies

Participants were asked how new vegetables could be introduced at their family meals.

Methods Used to Introduce New Vegetables

Participants in all groups suggested altering the flavor by adding butter, cheese, ketchup, onions, spices or meat and camouflaging the vegetable in stews, soups, or casseroles. All groups felt tasting a vegetable at a store, restaurant or social event could inspire offering it at a family meal. Taste approval reduced the likelihood it would be wasted if prepared.

Discussion

Our data analysis indicated that Exchange Theory could be a useful framework for future research examining food choices for family meals. In this study, food preparers felt serving most vegetables produced few rewards and high costs and evoked negative feelings, based on comparisons to family norms and past experiences. The outcome was that vegetable variety served was limited to only those liked by everyone and serving easy to identify new vegetables was avoided. Liker/disliker status did not affect perceptions of rules used to select vegetables for these shared meals. If the food preparer or any other member of the family disliked a vegetable it generally was not served.

Rewards our participants associated with foods served were indirect such as ‘meeting expectations’ (fixing foods everyone liked, serving on time, conformity to expected meal pattern, filling them up, complementing meat), positive family member reactions (eating what is served, occasional requests for certain dishes, eating at least a small variety of vegetables), and especially lack of conflict (no fights over tasting or finishing item, no negative comments). Serving potatoes garnered these rewards plus the personal reward of convenience (great familiarity, versatility, and adaptability to the situation). Sweet vegetables were most acceptable and rewarding to serve, as also found in Scottish families (Marshall et al., 1995). Consumers prefer sweeter vegetables to bitter and vegetable sweetness positively predicts intake (Dinehart et al., 2006). At family meals, rewards of serving meat and potatoes generally outweighed rewards of serving vegetables, in agreement with findings that meat is the center of a proper meal (Charles & Kerr, 1988) and vegetables are ‘second best’ (Marshall et al., 1995). Low-income women have reported spending over one-third of their food stamp allotment on meat, which they viewed as essential for dinner and a symbol of success and status (Bradbard et al., 1997).

More costs were associated with serving a greater variety of vegetables compared to meat and potatoes. Costs were tangible (money lost on rejected vegetables, lack of availability or greater expense for some forms, time required to learn new preparation methods and recipes, efforts needed to try new unfamiliar vegetables and introduce flexibility into meal choices), personal (overcoming personal aversions, not fulfilling role expectations) and social (family member objections, disagreements, rejection). Too few large supermarkets can limit availability of inexpensive vegetables in rural, low-income Appalachia (Prevention Institute, 2002). Unfortunately, individuals consume fewer vegetables when they appear too costly (Mushi-Brunt et al., 2007). Others have reported some but not all of these costs as barriers to fruit and vegetable consumption among low-income audiences (Reicks et al., 1994; Treiman et al., 1996). But our focus on unfamiliar, protective savory vegetables illuminated the role of and extent of personal aversions and social costs of changing vegetable choices.

Acceptable family vegetable choices evolved over time based on reactions to those presented. This past history, the overwhelming preference for sweet vegetables and the intra-family norm of only serving what everyone liked produced a restricted subset of acceptable vegetables and limited the ability to introduce new ones as found for Scottish families (Marshall et al., 1995). In addition, the norm of favoring husbands' and children's preferences, also noted in other studies (Brown & Miller, 2002; Kerr & Charles, 1986; Stratton & Bromley, 1999), reduced the power of female food preparers, who might favor more adventurous vegetable choices, to institute change. These factors (past history and family norms), combined with parents' allowing children to refuse any food and general absence of rules about trying new foods, would make incorporation of new vegetables, especially those we emphasized (cruciferous, deep orange, dark green leafy), into family meals difficult. Having family rules for tasting and eating vegetables positively correlates with children's consumption (Vereecken et al., 2005). Our participants' intake of our emphasized vegetables was low, as reported for Americans in general (Guenther et al., 2006; Johnston et al., 2000), probably due to both the savory flavor and their general unfamiliarity. Our participants highlighted the low acceptability of most vegetables by focusing on disguising or hiding these if served. Other low-income women have also suggested sauces, dips and seasonings to “doctor up” vegetables for families (Reicks et al., 1994).

The pairing of meat (including wild game) and potatoes with a conventional group of vegetables that includes corn, peas, carrots and green beans (Flasher, 1995; Sohn, 2005) remains the traditional Appalachian meal pattern in the two counties of interest. Both hunting and vegetable gardening can contribute to dinner menus. Growing cruciferous, deep orange and dark leafy green vegetables in gardens overcomes availability and cost issues and encourages more vegetable experimentation, especially among children. This approach might be ideally suited to this audience, where gardening is still fairly common (Flasher, 1995).

This study has limitations. The focus group setting could have inhibited opposing views or encouraged socially desirable responses, although sample stratification should have minimized this. Other limitations include self-report measures, a relatively low participation rate, and use of a small convenience sample from a specific geographic location that limit generalizability to all of Appalachia. Our results should be applied cautiously. Despite these limitations, this study had substantial strengths. It was theory-driven, methodologically strong and our stratification by sex and vegetable liking status provided new perspectives. It tapped low-income, rural Appalachian resident opinions and provided rich descriptive data.

Implications for Research and Practice

Nutrition interventions have attempted to reduce the high tangible costs of serving new vegetables by increasing access through farmers markets, food preparation skills and providing recipes and have had limited impact on vegetable intake (Anliker et al., 1992; Ciliska et al., 2000; Devine et al., 2005; Havas et al., 2003). But the influence of past experience and family norms has received little attention. Past experience plus food preparer expectations and deference to male or children's preferences supports a family norm of serving only vegetables liked by all family members. Lack of rules about and interest in trying new foods reinforce the limited vegetable variety served. Our emphasized vegetables were largely ignored due to their unfamiliarity and family norms that prevented experimentation and learning through exposure. Based on our findings, interventions to increase vegetable consumption of this target audience could consider:

• Altering *family norms* about vegetables served by enlisting representative food preparers who have successfully used rules about introducing and tasting new foods to help target families implement such rules; encouraging families to form teams (i.e. parent and child) that support regularly trying a new vegetable and continued serving of a vegetable liked by the team even if all family members do not like it; having families discuss their expectations of the food preparer, whether these are reasonable and what might be changed; and encouraging open family discussion about serving vegetables not liked by one family member on occasions when they are not present and working up to serving these when they are present with an alternative they like.

• Changing perceptions of *past experiences* by having families discuss positive experiences with new foods in the past; providing recipes that 'hide' new mild protective vegetables like kale or cauliflower with encouragement to serve these with no identification and, after eating it several times, discuss the content; and enlisting grandparent help with incorporating new vegetables into cross generation family meals.

• Reducing the *social and personal costs* of serving vegetables by helping families negotiate a rule for introducing new foods like vegetables, which might require everyone present to at least taste one or two bites of the new food; providing 'test recipes' that make perhaps two servings for a side dish and encourage repeat serving once or twice a month of those that at least two family members like; and developing short introduction sessions where an unfamiliar vegetable is served raw and cooked in small amounts so family members can examine the taste, texture and smell and training food preparers to do this once a quarter.

• Increasing the *tangible and social rewards* of serving vegetables by providing seeds and instructions for growing and using the emphasized vegetables in home gardens; helping the target audience identify recipes for these vegetables that complement meat main dishes (including venison and game) and match menu patterns; and offering one dish recipes that combine these vegetables with potatoes and or meat.

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Table 2-1. Focus group discussion questions within Exchange Theory framework

Con-struct	**Topics**	**Focus group questions** (not necessarily asked in this order)
Norms	Definition and ideal meals	What is your definition of a family meal? (Who? When? Where? How often?) What is the composition of a 'good' family meal?
	Roles and responsibilities	Who prepares the family meals in your household? What are the food preparer responsibilities?
Rewards /Costs	Meat and potatoes	What words come to mind when you hear the word: a) 'meat'? b) 'potatoes'? How would your family members answer? What are your favorite forms?
	Vegetables	What words come to mind when you hear the word 'vegetable'? How would your family members answer? What vegetables do you like/dislike and why? What might stand in your way of offering new vegetables?
Compar-ison Level	Vegetables acceptable now	What vegetables are acceptable/unacceptable for your family meals? What disagreements have you had in your family over vegetables?
	Reactions to new vegetables	What would be your/your family members' reaction to having a new vegetable at family meals? [Show examples of emphasized vegetables.]
Out-comes	Meal patterns	How does the food preparer choose the foods/vegetables for a family meal? How do family members' likes/dislikes affect the vegetables served?
	Freedom to change menus	How much freedom does the food preparer have to change the menus of family meals?
Strat-egies	Methods to introduce new vegetables	What methods have been used to offer 'new' vegetables at your family meals? What might encourage you to try to offer new vegetables?

Table 2-2. Participant characteristics (N=61)[1,2]

	Men (n=28)	**Women (n=33)**
Age of self, y (*mean* ± *SD*)	49.0 ± 7.2	47.4 ± 6.3
Age of partner, y (*mean* ± *SD*)	46.8 ± 9.0	48.9 ± 8.0
Years lived with partner (*mean* ± *SD*)	16.4 ± 10.9	16.6 ± 11.1
Ethnicity		
White (non-Hispanic)	26 (93%)	31 (94%)
Black (non-Hispanic)	2 (7%)	1 (3%)
Hispanic	0 (0%)	1 (3%)
Total in household (*mean* ± *SD*)	2.9 ± 0.9	3.4 ± 1.3
Education level		
Some high school	8 (29%)	6 (18%)
High school diploma or GED	11 (39%)	16 (49%)
Trade/business school or college	9 (32%)	11 (33%)
Employment status		
Employed	11 (39%)	11 (33%)
Unemployed	12 (43%)	17 (52%)
Retired/Other	5 (18%)	5 (15%)
Income range		
Less than $10,000	6 (21%)	8 (24%)
$10,001 to $20,000	13 (46%)	8 (24%)
$20,001 to $30,000	4 (14%)	8 (24%)
$30,001 to $40,000	5 (18%)	9 (27%)

1 Some totals do not sum to 100% due to round-off error.

2 There were no significant differences between men versus women or vegetable-likers versus dislikers.

Table 2-3. Vegetable liking, intake and serving patterns *(means ± SD)*

	Vegetable-likers			Vegetable-dislikers		
	Men (n=13)	**Women (n=18)**	**Total (n=31)**	**Men (n=15)**	**Women (n=15)**	**Total (n=30)**
Liking scores[1]						
Cruciferous vegetables[2]	4.3 ± 0.4	4.5 ± 0.6	4.4 ± 0.5[a]	2.3 ± 1.0	2.9 ± 1.0	2.6 ± 1.0[a]
Deep orange vegetables[3]	3.6 ± 0.7	3.9 ± 0.9	3.8 ± 0.9[a]	2.4 ± 0.6	2.8 ± 0.8	2.6 ± 0.7[a]
Dark green leafy vegetables[4]	3.3 ± 0.7	3.5 ± 0.7	3.4 ± 0.7[a]	2.0 ± 0.7	2.4 ± 0.9	2.2 ± 0.8[a]
Corn	4.3 ± 0.6	4.7 ± 0.6	4.5 ± 0.6	4.3 ± 1.0	4.5 ± 0.5	4.4 ± 0.8
Potatoes	4.4 ± 0.5	4.6 ± 0.6	4.5 ± 0.6	4.8 ± 0.4[b]	4.3 ± 0.5[b]	4.5 ± 0.5
Tomatoes	4.1 ± 1.0[b]	4.7 ± 0.5[b]	4.4 ± 0.8[a]	3.8 ± 1.3	3.6 ± 1.5	3.7 ± 1.3[a]
Personal intake over the last month *(times/week)*						
Cruciferous vegetables	1.7 ± 1.9	1.2 ± 1.2	1.4 ± 1.5[a]	0.7 ± 0.5	0.4 ± 0.5	0.6 ± 0.6[a]
Deep orange vegetables	1.8 ± 1.7	1.0 ± 1.0	1.3 ± 1.4[a]	0.7 ± 0.9	0.5 ± 0.6	0.6 ± 0.7[a]
Dark green leafy vegetables	1.5 ± 1.7	1.3 ± 1.7	1.4 ± 1.7	0.7 ± 0.9	0.8 ± 1.4	0.7 ± 1.2
Potatoes[5]	2.1 ± 1.2	1.4 ± 1.0	1.7 ± 1.1	2.0 ± 1.0[b]	1.2 ± 0.9[b]	1.6 ± 1.0
Tomato sauce	1.3 ± 0.8	1.6 ± 1.7	1.4 ± 1.4	2.4 ± 2.1	1.2 ± 1.7	1.8 ± 1.9
Frequency served at family meals over the last month *(times/week)*						
Cruciferous vegetables	1.4 ± 1.5	1.5 ± 1.6	1.4 ± 1.5[a]	0.4 ± 0.6	1.0 ± 1.3	0.7 ± 1.0[a]
Deep orange vegetables	1.2 ± 1.4	0.8 ± 0.9	1.0 ± 1.1[a]	0.4 ± 0.3	0.4 ± 0.6	0.4 ± 0.5[a]
Dark green leafy vegetables	1.5 ± 1.9	1.4 ± 2.0	1.5 ± 1.9[a]	0.8 ± 1.2	0.3 ± 0.6	0.5 ± 1.0[a]
Potatoes[5]	1.4 ± 1.0	1.4 ± 1.0	1.4 ± 1.0	1.3 ± 0.8	1.1 ± 0.8	1.2 ± 0.8
Tomato sauce	1.2 ± 0.9	1.3 ± 1.0	1.2 ± 0.9	1.2 ± 0.8	1.2 ± 1.7	1.2 ± 1.3

1 Based on a scale of 1=strongly dislike, 2=dislike, 3=neutral or don't know, 4=like, and 5=strongly like
2 Average score for broccoli, cauliflower, cabbage, and Brussels sprouts (Cronbach's alpha = 0.87)
3 Average score for carrots, pumpkin, butternut squash and acorn squash (Cronbach's alpha = 0.78)
4 Average score for dark lettuce, spinach, collards, mustard greens, kale, and Swiss chard (Cronbach's alpha = 0.86)
5 Average score for French fries or fried potatoes and other white potatoes
a Scores for total vegetable-likers versus total vegetable-dislikers differ significantly ($p<.05$)
b Scores for men versus women within same vegetable-liker/disliker group differ significantly ($p<.05$)

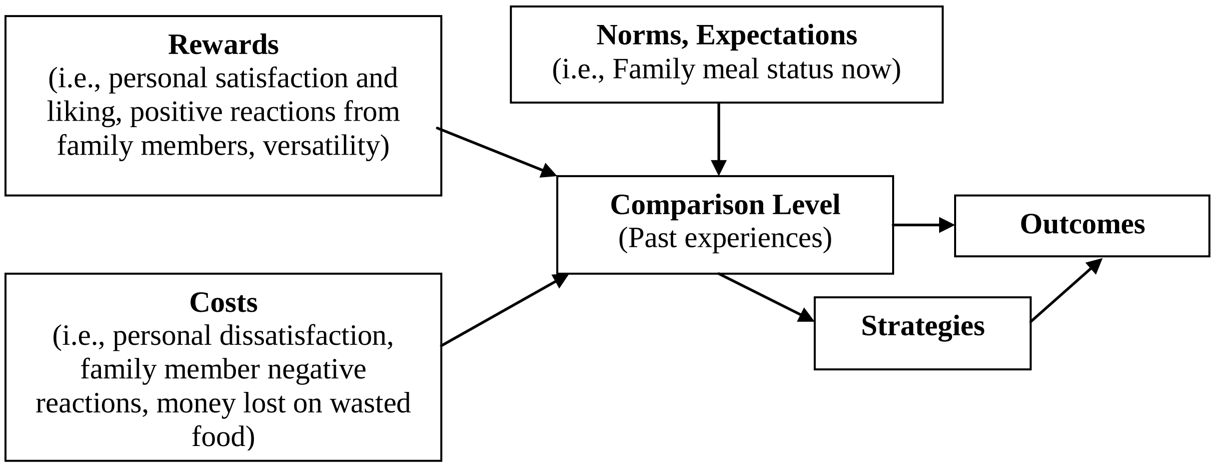

Figure 2-1. Exchange Theory Model (Sabatelli & Shehan, 1993) as adapted for this study.

Model constructs are in bold, with examples relevant to this study in parentheses.

Chapter 3
Impact of a community-based intervention on serving and intake of vegetables among low-income, rural Appalachian families

Introduction

Increasing fruit and vegetable intake is a potential weight control strategy (Rolls et al., 2004) that may also protect against various health problems including cancer, heart disease and diabetes (Bazzano, 2006; Van Duyn & Pivonka, 2000). Depending on age, sex and physical activity level, daily recommended intake of fruits and vegetables for adults now is at least 3.5 to 5 cups a day (USDA), although few Americans meet these or previous recommendations (Casagrande et al., 2007; Guenther et al., 2006; Kimmons et al., 2009). In studies published between 2000 and 2009, the average American adult intake ranged from about 3 to 5 daily ½-cup servings (1.5 to 2.5 cups), with potatoes usually being the biggest vegetable contributor (Casagrande et al., 2007; Guenther et al., 2006; Johnston et al., 2000; Kimmons et al., 2009). Low-income individuals, who suffer more chronic diseases compared to their wealthier counterparts (US Department of Health and Human Services, 2000), ate even fewer fruits and vegetables (Casagrande et al., 2007).

Behavioral dietary interventions published between 1966 and 2001 had modest influence on fruit and vegetable intake (Bowen & Beresford, 2002). Among interventions published between 1975 and 1999 reviewed by Ammerman et al. (2002), experimental groups on average increased their daily fruit and vegetable intake by 17% (equivalent to 0.6 servings) more than controls at follow-up one, although the intervention effect decreased to just 7% by follow-up two. Interventions in Ammerman et al.'s (2002) review and elsewhere regularly report fruit and vegetable intake together as a composite value (e.g., Anderson et al., 2001; Havas et al, 1998; Havas et al., 2003; Lutz et al., 1999; Marcus et al., 1998; Shankar et al., 2007). Studies reporting the two intakes separately often discover that the biggest contributor to the increase in fruit and vegetable consumption is higher fruit as opposed to higher vegetable intake (Ammerman et al., 2001; Campbell et al., 1999; Devine et al., 2005; Stables et al., 2002). Resnicow et al. (2001) did report a significant net increase in overall vegetable intake (excluding fried potatoes) of about 0.5 daily servings (mean of three food frequency questionnaire assessments) among participants in church groups receiving a culturally sensitive self-help intervention supplemented with motivational interviewing compared to participants in church groups receiving a control treatment of standard nutrition education materials. Because vegetable intake is so hard to alter, future nutrition interventions need to focus on increasing vegetable consumption specifically (Stables et al., 2002; Trudeau et al., 1998). Targeting the more protective deep orange, cruciferous and dark green vegetables, where the average adult intake is approximately 0.2 daily ½-cup servings each (Guenther et al., 2006; Johnston et al., 2000), may provide protection against cancer and other chronic disease (Van Duyn & Pivonka, 2000).

There are many reported barriers to changing fruit and vegetable intake (John & Ziebland, 2004; Maclellan et al., 2004; Reicks et al., 1994; Treiman et al., 1996) as well as general food choices (Hampson et al., 2009; Hartman et al., 1994; McGee et al., 2008). These include lack of food related skills, familiarity, and knowledge of healthful foods, family member food preferences, high cost, requiring too much time and effort, limited availability, negative childhood memories, and personal dislike of healthful foods or preference for other foods. Nutrition interventions traditionally target the female food preparer, who does most of the meal planning, shopping and cooking and is considered the gatekeeper to the family diet (De Bourdeaudhuij, 1997; Harnack et al. 1998; Lewin, 1943), assuming that if she attains the necessary knowledge and skills, she can instigate change in family member food choices. But studies indicate that the food preparer makes those foods that her family likes and will eat (Charles & Kerr, 1988; De Bourdeaudhuij & Van Oost, 1998), and her desire to avoid conflict at mealtime often overrides her desire to serve healthful foods (Anderson et al., 1995; Backett, 1992; Backett et al., 1994; Brown & Miller, 2002). Numerous studies report that food preferences of the male partner largely determine what foods are served at family meals (De Bourdeaudhuij, 1997; DeVault, 1987; Jansson, 1995; Kerr & Charles, 1986; Pill & Parry, 1989). Children also influence family food choices (DeVault, 1987; Kerr & Charles, 1986; Pill & Parry, 1989; Stratton & Bromley, 1999). In turn, women may serve fewer foods they prefer such as casseroles, certain vegetables or pasta, and more foods their partners prefer such as meat and potatoes (Brown & Miller, 2002). Researchers need a better understanding on how family members influence vegetable choices at shared family meals, especially in low-income, rural Appalachian families. To date there are no documented approaches to successfully engage the male partner and children in bringing new vegetable choices into meals.

Husbands' diets have been shown to improve slightly when their wives were enrolled in low-fat dietary interventions (Shattuck et al., 1992; White et al., 1991), suggesting that women can have a limited effect on family food choices. However, there is no similar evidence that food preparers 'trained' in a nutrition education intervention can alter family member vegetable intake, given that only the vegetable intake of the food preparer is evaluated after training, and not intake of other family members.

A theoretical framework should guide the design of a nutrition intervention. Social Cognitive Theory (SCT) proposes that an individual's behavior is constantly being influenced by their environment and their personal characteristics and visa versa. This is called 'reciprocal determinism.' SCT constructs, defined in Table 3-1, including the physical environment, degree of social support, personal expectations of a behavior, behavioral capability, personal self-efficacy, observational learning, and reinforcement of behaviors (Baranowski, 1997; Baranowski et al., 1997), guided the design of a community-based intervention to promote wellness. A key focus of the intervention was increasing the serving and eating of deep orange, cruciferous and dark green leafy vegetables (called our target vegetables) at family meals, with portion size control, choosing low-energy-density foods and increasing physical activity also discussed. The objective of the study was to pilot test this intervention among a sample of low-income, rural food preparers and their partners drawn from an Appalachian county. This intervention sought to eliminate most of the barriers described above (lack of skills, familiarity, and knowledge, family member food preferences, reduce cost, time and effort, and increase availability). Although not addressed directly, it was hoped that the intervention would reverse negative childhood memories and increase preference for the target vegetables.

This study evaluated whether trained food preparers could affect their partner's intake, by having both food preparers and partners provide quantitative data (i.e., vegetable intake and frequency served at meals, readiness-to-eat more vegetables). Understanding of food preparer and partner experiences were further enriched qualitatively through couple interviews. These interviews were designed and analyzed using Baranowski and Hearn's (1997) reciprocal determinism model, an extension of the reciprocal determinism concept in SCT, which proposes that personal characteristics (i.e., food preferences, self-efficacy) interact with specific family characteristics (the family food system and family functioning) to influence dietary behavior (i.e., vegetable intake, dinner patterns) within the family environment (see Figure 3-1). Family functioning was assessed using flexibility, based on roles, rules and power structure, from the Circumplex Model of Marital and Family Systems (Olson & Gorall, 2003). This Model describes three dimensions of family functioning: flexibility, cohesion and communication. The present study focused on flexibility, which was used to describe the amount of change allowable at baseline and achieved post-intervention within a family's roles, rules and power structure.

Methodology

Study Design and Recruitment

The Pennsylvania State University Institutional Review Board approved this pilot test of a randomized, parallel-group, community-based intervention to promote family wellness that used a pre/post/3-month follow-up design.

Volunteers were recruited within an Appalachian county primarily through newspaper advertisements and flyers displayed in the community (churches, doctor's offices, libraries, community housing sites, schools, etc.) and screened by telephone to insure food preparers (female or male) and their partners met the following criteria: (1) married or cohabiting for at least a year; (2) at least one partner age 35 or older (an age when they may realize that diet affects their health); (3) at least one child aged 7 to 25 years living at home (to learn the impact of children on dinner food choices); (4) household income of no more than $50,000; (5) family eats main meals together at least four times a week, and (6) food preparer BMI $\geq$ 25 (in overweight category to insure emphasis on low-energy-density food choices was relevant to participants). Fifty-two qualified couples were enrolled, completed baseline measurements, stratified by food preparer sex, and randomly assigned to either the intervention (n=26 couples) or control (n=26 couples) treatment. One couple from each treatment dropped out after randomization and before the intervention and was not included in any analyses.

Intervention

The experimental treatment consisted of eight weekly 2-hour meetings, which were offered three times a week in two locations and took place January through February of 2008. Meeting (i.e., lesson) content and activities were based on Social Cognitive Theory constructs (Baranowski, 1997; Baranowski et al., 1997; see Table 3-1). Lessons addressed: 1) portion control and low-energy-density eating; 2) increasing activity by taking more steps; 3) deep orange vegetables; 4) cruciferous vegetables; 5) fruit (included as a ‘treat’ and break from vegetables); 6) mild dark green leafy vegetables; 7) savory dark green leafy vegetables; and 8) review and focus group session. Lesson 1 included an introduction to the lesson series plus strategies for portion control and low-energy-density eating (i.e., filling up on foods with high water content such as vegetables at a meal, in turn eating fewer calories from the remainder of the meal) (Rolls, 2005). Lesson 2 highlighted the importance of physical activity through the use of a PowerPoint presentation, included a walking session, and encouraged increasing daily walking by five minutes every two weeks. Participants were asked to complete step logs (described below) the week following lessons 2, 4, 6 and 8. Lessons 3 through 7 covered the nutritional value, how to choose, store and prepare, and introduce the highlighted vegetables or fruit to others with recipes prepared in class. Lesson 8 included a lesson review, catered meal featuring target vegetables, fruits, and other low-energy-dense dishes, and focus group feedback session to evaluate the program.

Lessons used visual demonstrations, offered tasting opportunities for raw and cooked vegetables and fruits, comparative data (cost, nutritional value, etc.) on available forms (fresh, frozen, canned) and handouts covering ideas for increasing physical activity, vegetable and fruit tips (selecting and storing, preparing and cooking, and introducing to others), growing vegetables in home gardens, and picking, freezing, and eating a variety of fruit. At six of the meetings (all but lessons 2 and 8), food preparers were assigned to one of three teams to prepare a recipe in sufficient quantity that everyone in the meeting could take home three different recipes ready to heat and serve to their family. To document participants' experience with the recipes, food preparers were asked to complete meal diary forms (described below) for each set of recipes during the week following their preparation and return the forms to the instructor. When dishes were taken home, intervention participants were encouraged to take on the role of change agent and to develop tasting rules for the dishes, both of which could increase family flexibility around incorporating new vegetables into family meals (Olson & Gorall, 2003). Attendance records were kept at all eight meetings. Incentives included $10 for each lesson attended plus a $70 bonus for attending at least six.

The intervention lessons were based on an original lesson series designed to increase family acceptance of functional vegetables including those from the deep orange, cruciferous and dark green leafy families. Cognitive interviews with 8 target audience members using representative lessons of this original series were used to revise and increase the clarity and impact of the intervention lesson series.

The intervention lessons were further enriched to specifically address frequently cited barriers to changing food choices (Dittus et al., 1995; Hartman et al., 1994; Hampson et al., 2009; John & Ziebland, 2004; Maclellan et al., 2004; McGee et al., 2008; Reicks et al., 1994; Treiman et al., 1996). These barriers include skills, familiarity, knowledge, family member food preferences, cost, time and effort, and availability. Skills and familiarity were addressed through in-class tasting and recipe preparation while knowledge was addressed through visual demonstrations, comparative data, and handouts. Family member food preferences were dealt with by sending participants home with ready-made dishes not necessarily matching prior family preferences to introduce into meals and encouraging participants to enact rules requiring at least tasting the dishes. Cost, time and effort were reduced by providing recipe ingredients, introducing less expensive heat and serve forms (i.e., frozen or canned), giving tips for adding these to other dishes, and instructing how to prepare less expensive raw forms like whole squash or kale (this reduced cost only). Availability was increased by providing instruction for growing vegetables in home gardens as well as emphasizing use of canned or frozen forms where relevant.

Recipes used in the lessons were tested by a research team who considered ease of preparation, ability to withstand travel and reheating, and taste. Recipes chosen had seven or fewer major ingredients (not including spices or water) and no more than 400 mg sodium (except one main dish soup) or 11g of fat and had at least 2g of fiber per serving.

In the control treatment, food preparers were mailed eight weekly packets in sequence with the experimental lessons. This weekly packet included the same handouts and recipes received by experimentals along with the relevant step log (SL) and meal diary (MD) plus a cover letter introducing the participant to the packet contents.

Evaluation Measures

The intervention flow chart outlines intervention timing, when evaluation measures were collected and number participating in each step (Figure 3-2). Quantitative data collection and couple interviews were done in participants' homes (n=47 couples), on the university campus (n=2 couples) or in the researcher's home (n=1 couple) per participants' request. Food preparers and partners provided written informed consent at the baseline home visit prior to baseline quantitative data collection. Separate informed consent forms were signed prior to the initial couple interview for these selected to complete the interviews. Pro-rated incentives were provided for instruments (range $1-$10 per form) and interviews ($25 per couple).

Impact Measures

Readiness-to-Eat More Vegetables (RE)

RE, one item with five response options previously validated with limited resource women, was based on the stage-of-change algorithm (Townsend, 2005) and completed by food preparers and partners. Stages were coded as 1=pre-contemplation (not thinking about eating more vegetables), 2=contemplation (thinking about eating more vegetables; planning to start within 6 months), 3=preparation (definitely planning to eat more vegetables in the next month), 4=action (trying to eat more vegetables now) and 5=maintenance (already eating 3 or more servings of vegetables a day).

Self-Efficacy (SE)

Seven items, previously validated with limited resource women, assessed food preparer's confidence in fixing and eating 'generic' vegetables and fruits in various circumstances (Townsend, 2005). Response categories used a 3-point scale (1=disagree to 3=agree).

Diet History Questionnaire (DHQ)

The previously validated Diet History Questionnaire (DHQ; Version 1.0; National Institutes of Health, Applied Research Program (ARP), National Cancer Institute (NCI); 2002) was used to assess food preparer's dietary intake (Subar et al., 2001; Thompson et al., 2002). Usual frequency of intake was indicated using ten predefined response options ranging from ‘never’ to ‘6 or more times/day’ for beverages or ‘2 or more times/day’ for foods and portion size using three predefined response options. The DHQ was revised to assess intake over the past six months (rather than the past 12 months) to more clearly capture any changes in intake of the intervention’s target vegetables. A question on intake of winter squash/pumpkin was added following NCI staff directions, resulting in 145 items total that took about an hour to complete. The DHQ was self-administered twice - at baseline and the 3-month follow-up. A researcher was present to clarify participant questions about items on the questionnaire and assist in choosing frequency or portion size options.

Vegetable Intake Assessment (VIA)

This form gathered information in five distinct areas: a) intake during the previous month of the target vegetables (8 items taken verbatim from the DHQ, one item (squash/pumpkin) whose portion size options were each ¼ cup less than on the DHQ due to error, and one additional item (dark lettuce) that was not assessed separately in the DHQ), b) number of family meals eaten together per week during the previous month (1 item), c) how often the target vegetables were served at family meals during the previous month (10 items mirroring the ten intake questions), d) vegetable-like/dislike (19 items rated on a 5-point scale ranging from 1=strongly dislike to 5=strongly like) and e) beliefs about perceived disease risk and the influence of vegetables thereon (6-7 items rated on a 5-point scale ranging from 1=strongly disagree to 5=strongly agree). The items in (a) most copied verbatim from the DHQ, allowed the capture of target vegetable intake at three time points for both food preparers and partners without requiring all participants to complete the lengthier DHQ at all three time points. This also allowed the comparison of DHQ and VIA values for food preparers at baseline and 3-month follow-up. Face validity of the VIA was established through cognitive interviews conducted in December 2005 with six members of the target audience.

Step Log (SL)

Food preparers were instructed to record type and duration of all activities over seven days. The step log completed the week after its introduction at lesson 2 was baseline, after lesson 8 was post-test and after the last home visit was 3-month follow-up (i.e., step logs completed after lessons 4 and 6 were not scored but included to maintain motivation). Routine activities listed on logs such as housekeeping activities (i.e., cooking, cleaning, child care), sitting or driving, standing and self-care (i.e., eating, bathing, dressing) were not counted and the remaining activities were converted into step equivalents per minute (spm) using metabolic equivalent (MET) values from the Compendium of Physical Activities (Ainsworth et al., 2000). The lowest intensity level was assumed if multiple levels were available for a specific activity. The MET/spm for walking at 3 miles per hour (mph) was used as a reference to compute spm for each activity (personal communication, Dr. David Bassett, Department of Exercise, Sport, and Leisure Studies, University of Tennessee, July 1, 2008). Walking at 3 mph, which has an MET of 3.3 (Ainsworth et al., 2000), yields 100 spm. Inserting a specific activity's MET value from the Compendium into the following equation provided approximate spm for that activity.

$$\frac{3.3}{100} = \frac{\text{MET value from Compendium}}{\text{spm}}$$

The calculated spm for each activity was then multiplied by the number of minutes a participant was engaged in that activity to calculate the number of respective step equivalents.

Recipe Use (RU)

Form on which food preparers indicated the number of times each intervention recipe was prepared outside of class. Analysis of recipe use excluded experimentals attending one or fewer lessons because they did not receive the recipes and, for the remaining participants, listed 11 vegetable recipes to coincide with vegetables considered in the cluster ‘total in recipes’ described below.

Process Measures

Couple Interviews

Ten couples were randomly selected from each treatment to complete two sequential interviews - one at baseline and one immediately post-intervention using a semi-structured interview script. The interviewer was trained by conducting previous interviews with the target population and through discussion, guidance and feedback from an experienced interviewer on initial interviews in this study. Script development was guided by Baranowski and Hearn’s (1997) reciprocal determinism model, which proposes a dynamic interaction between personal characteristics, behavior and the environment. Constructs in that model and in ‘flexibility’ from the Circumplex Model of Marital and Family Systems (Olson & Gorall, 2003)] were used to design open-ended questions that addressed a) family member personal characteristics (member vegetable preferences, food preparer self-efficacy); b) the external and internal family food system; c) family functioning through *roles* (including role expectations or the duties surrounding meal shopping, preparing and serving that a food preparer attempts to fulfill), *rules* for meal components or tasting/eating foods, *power* or influence over vegetable choices, and *flexibility* to incorporate new vegetables into meals; and d) dinner meal patterns. Scripted questions and probes were refined on subsequent interviews based on experiences of the first several interviews.

Interview sequence involved meeting with first the couple together and then each partner separately. Baseline interviews were conducted with all twenty couples, with questions addressing the model constructs. Seventeen couples (n=10 experimental; n=7 control) agreed to complete a second interview with three declining due to personal schedule conflicts. Post-intervention questions probed for changes from baseline plus assessed experiences with the experimental lessons or control mailed materials and penetration of recipes into family meals. Interviews lasted about 1.5 hours and were audio-taped.

Meal Diary (MD)

When weekly intervention recipes were taken home, both experimental and control food preparers were asked to complete a brief meal diary form to assess a) use of the three recipes (i.e., day of the week served, other items served with it, family vote results, other comments i.e., likes/dislikes), b) any additional use (other than in the recipes) of the vegetables/fruits featured and c) family reactions to the three recipes during the following week. For each recipe, scores of 0=refused; 1=tasted; 2=ate were assigned to each of three family members, the food preparer, partner and a child. These scores were summed to provide a total family score ranging from 0 to 6 for each recipe. A total family score of 5 for a recipe meant two parents and a child all tasted it and two ate it; a score of 6 meant they all tasted it and ate it. A family meal diary score was calculated, which represented total number of recipes (range 0 to 15) for which each family scored a 5 or 6. Family meal diary scores were divided into low (0 to 6) and high (7 to 15) MD score groups for comparisons. Fruit lesson recipes, which were highly popular, were not included in this scoring.

Focus Groups

These were held with experimental food preparers during the eighth meeting at each meeting time and location (n=3). A trained moderator with extensive qualitative experience conducted all three sessions. The scripted questions addressed what was liked and disliked about the lessons and recipes, experiences with their family members with dishes brought home, and suggestions for lesson improvement. Focus groups lasted about one hour and were audio-taped.

Data Analysis

Quantitative

Data were analyzed using the Statistical Package for the Social Sciences (version 11.5, 2002, SPSS Inc, Chicago, IL). Demographic characteristics are presented using descriptive statistics. Multiple option data (RE, SE, vegetable-liking, perceived risk and the influence of vegetables thereon) were treated as numerical data using mean scores. RE response options were also collapsed into more condensed categories and treated as categorical data for baseline comparisons between treatments, for food preparers and partners separately, as noted in the footnote to Table 3-3. Target vegetable intake from the VIA and DHQ, expressed as MyPyramid cup equivalents per week (i.e., cups/week), was calculated by multiplying the selected frequency by the MyPyramid cup equivalent in the DHQ nutrient database (dhq1_121107.csv; NCI, ARP) corresponding to the selected portion size. Squash/pumpkin portion sizes on the VIA were scored as if they were identical to the DHQ. The Diet*Calc analysis program (Version 1.4.3; NCI, ARP; November 2005) was used to analyze target nutrient and total vegetable intake from the DHQ. Target vegetable intake was also examined in the following clusters: a) total target (deep orange, cruciferous, plus dark green leafy), b) total target minus the biggest contributors to each vegetable group – carrots, broccoli and lettuce (‘total-C,B,L’) and c) ‘total in recipes’ (sweet potatoes, squash/pumpkin, cauliflower/Brussels sprouts, cooked greens and raw greens – excluded carrots, broccoli and lettuce as well as cabbage and coleslaw, which were not in the recipes).

Baseline differences between treatments were compared for food preparers and partners separately using two-sided *t*-tests for numerical variables and chi-square and Fisher’s exact tests (for 2x2 contingency tables) for categorical variables. To improve normality and reduce skewness for analysis, vegetable intake data from the VIA and DHQ were square-root transformed (Greene et al., 2004). Nutrient intake data from the DHQ were adjusted for energy intake. Untransformed values are presented in tables. Relative agreement of square-root transformed vegetable intake responses between the VIA and DHQ (for food preparers), and between food preparers and partners (for VIA data), was assessed by Spearman rank correlation coefficients.

For analysis, one experimental couple was dropped from post-intervention data because the food preparer attended only one meeting (and concurrently joined and attended another wellness program). This couple provided immediate post-test but no 3-month follow-up couple data and was excluded from both post-intervention data sets to avoid data contamination.

Data cleanup revealed that four food preparers and three partners (one of each who were a couple) had extreme baseline values for personal intake (greater than three times the inter-quartile range between the first and third quartiles) of one or more of the target vegetable groups (i.e., deep orange, cruciferous, or dark green leafy total) as assessed by the VIA. Two of these food preparers also reported extremes of intake for at least one vegetable group in the DHQ. These extreme outliers were retained in the initial total treatment analysis but removed for subset analysis for each respective instrument.

Recipe use was compared between treatments at post-test and 3-month follow-up using two-sided *t*-tests. Other impact evaluation measurements (RE, SE, VIA variables, DHQ variables, step equivalents per day) and changes in target vegetable intake and frequency of serving based on meal diary scores were compared between treatments, for food preparers and partners separately, using a linear mixed model (LMM) for repeated measures (Gueorguieva & Krystal, 2004). The linear mixed model is an extension of the traditional analysis of variance model that can handle missing data more appropriately. The fixed factor effects in the model were group (usually group = experimental or control treatment; when comparing vegetable intake or frequency of serving by meal diary scores, group=low or high scores) and time. All analyses included the interaction between group and time. Pair-wise comparisons with the least significant difference test were used to compare changes between assessment points *within* groups. Independent t-tests were used to compare differences *between* groups at a given assessment point. All results were considered significant at $p \leq 0.05$.

Qualitative

Focus group and couple interview transcripts were transcribed verbatim by the graduate researcher. Focus groups were analyzed using principles outlined by Krueger (2000). Two researchers reviewed all transcripts and identified themes emerging from participant responses. The researcher who did not lead the focus groups summarized the major themes. The researcher who led the focus groups reviewed the summary and made minor modifications to improve readability.

Couple interviews were analyzed for themes using constant comparison (Glaser & Strauss, 1967). Coding lists were developed for each set of interviews (total baseline, post controls, post experimentals) by one researcher who reviewed several randomly selected interviews in that set and produced a coding list of mutually exclusive categories that reflected themes emerging in the interviews. A second researcher coded the same sample interviews using the coding list and adjustments were made to resolve disagreements. Then both researchers independently applied the relevant adjusted coding list to the remaining interviews in that set and wrote independent thematic summaries for each interview in that set and all other sets.

One researcher organized the thematic data into categories of supra-themes with relevant sub-themes (i.e., personal characteristics included 'picky food preparer,' roles included 'one shops, share cooking', etc.) for each interview set. Each researcher tagged each couple with sub-thematic categories based on their own thematic summaries. Agreement in categorization was 80% at baseline and ranged from 61 to 70% at immediate post-intervention for experimentals and controls, respectively. Further discussion led to mutual agreement in final couple categorizations. The researchers also considered 16 thematic categories to make a summary assessment of whether experimental couples were likely to change vegetables served, which resulted in 100% agreement in categorization. Supra-thematic categories were assigned to relevant reciprocal determinism constructs. Results are presented by construct. One experimental couple was removed from post-intervention couple interview analysis as the food preparer only attended one lesson meeting and the interview mirrored that of controls.

Results

Baseline Evaluation

Participant Demographic Characteristics

Food preparers and partners were middle aged, predominately white, married, lower-income with moderate education and averaged about 2 children living at home (Table 3-2). There were no significant differences between experimental and control food preparers or partners in any characteristic including public assistance received (data not shown). Self-reported food preparer BMI did not differ between treatments.

RE & SE

As shown in Table 3-3, ~90% of food preparers were in the action or maintenance stages for readiness-to-eat ‘generic’ vegetables at baseline, with no significant differences between experimental and control treatments. Fewer experimental partners were in these stages at baseline. Significantly more control partners were in action or maintenance compared to experimental partners (84% of controls versus 48% of experimentals; Fisher’s exact test: $p=0.016$).

There were no significant differences in baseline SE scores (Table 3-3). Food preparers in both treatments scored quite high, indicating that they had confidence in fixing and eating ‘generic’ vegetables in various circumstances. However, types of vegetables were not specified in this instrument.

Vegetable-Liking

Vegetable-liking scores for the deep orange and cruciferous vegetable groups were higher than those of the dark green leafy vegetable group (Table 3-3) but food preparer and partner liking scores were not significantly different between treatments.

Family Meals and Target Vegetables Served

There were no treatment differences, for food preparers or partners, in number of shared family meals (on average 5-6 per week) during the previous month (Table 3-3). Frequency of serving the cruciferous and dark green leafy vegetables at meals was higher than the orange vegetables, with no significant differences between treatments of food preparers or partners (Table 3-3). Broccoli, dark lettuce and carrots were the main target vegetables served.

Perceived Disease Risk and Influence of Vegetables Thereon

Perceived disease risk and influence of vegetables thereon did not differ by treatment for food preparers or partners (data not shown). Using a five-point scale (strongly disagree, disagree, not sure, agree, strongly agree) the average response was ‘not sure’ to statements regarding personal risk for developing cancer, heart disease and high blood pressure. Agreement to statements regarding the likelihood of vegetables affecting development of these diseases generally fell between ‘not sure’ and ‘agree.’

Target Vegetable Intake

Intakes per day as MyPyramid cup equivalents were so low that these intake data are reported as MyPyramid cup equivalents per week.

Food Preparers

DHQ derived total vegetable intake (including vegetables in mixed dishes like soups, etc. but excluding legumes) did not differ significantly between treatments and was 12.59±6.58 and 14.68±7.17 cups/week for experimental and control food preparers, respectively. DHQ and VIA derived baseline target vegetable intake values as MyPyramid cup equivalents per week for food preparers indicated that intake of cruciferous and dark green leafy vegetables was higher than that of the deep orange vegetables (Table 3-4a). In agreement with baseline frequency of vegetables served at meals, broccoli, lettuce and carrots were the most eaten vegetables in each respective group. Control food preparers did have a significantly higher intake (by about a quarter of a cup a week) of cauliflower/Brussels sprouts as assessed by the DHQ. Spearman correlation coefficients were above 0.5 for 9 of the 10 vegetables, indicating relatively good agreement between the two instruments. Correlations were 0.6 or better for statements copied directly from the DHQ to the VIA, suggesting the shorter VIA was an adequate alternative to the DHQ.

Partners

Similar to food preparers, partner intake of cruciferous and dark green leafy vegetables was higher than that of orange vegetables, with broccoli, dark lettuce and carrots being the biggest contributors in each group (Table 3-4b). Correlation coefficients of vegetable intake between food preparers and their partners were highest for dark green leafy vegetables (0.338) and lowest for cruciferous vegetables (0.231; Table 3-4c).

Couple Interviews

Analysis revealed a few minor baseline differences, mainly in aspects of their food systems and vegetable choices, between experimental and control couples. There were far more similarities between experimental and control families. Findings are presented using Reciprocal Determinism constructs.

Personal Characteristics

Member Vegetable Preferences: Parents, especially mothers, cited more liked vegetables than were reported for children. Among the target vegetables, broccoli, carrots, dark lettuce and sometimes cauliflower were most commonly listed while squashes and other dark leafy greens were rarely eaten. Most food preparers had broader vegetable tastes than their partners. Over half of the partners were picky (not always labeled as such, but disliked many familiar vegetables and refused to eat them) or clearly preferred meat, potatoes and starchy vegetables (corn, peas, carrots, etc). Only a few food preparers were picky. Some partners wished to stick with their learned, limited vegetable pattern but others reported vegetables like greens or things they grew up with were not served at meals, even though they liked these. Every couple had at least one picky child and often several who liked only a very limited number of vegetables. The most common acceptable vegetables for children were corn, peas, carrots, broccoli, green beans and sometimes lettuce, although almost no child was reported to like all of these. Salads and mixed dishes were picked apart by many children.

Family Food System

External Food System: Couples used primarily grocery stores, followed by big box stores and farmer's markets. A few couples also used specialty stores (meat, dairy) or cooperatives. One control partner routinely brought vegetables home from his job on a farm. Compared to experimentals, control couples shopped at more stores (n=4 experimental couples shopped at three or more stores; n=9 control couples did so).

Internal Food System: Family meals, an important family activity, generally were shared at least three to four times a week. In about half of the couples, all family members were present for family meals and in the remainder, family meals commonly lacked a parent or older child(ren). One control partner and his children ate at his mother's house on nights that his wife worked. Meals typically were planned around a meat or main dish, and included a starch and a vegetable. Half of the couples had vegetable gardens with most gardeners doing some freezing or canning. Many partners hunted, providing venison for meals, or received it from friends or family.

Family Functioning

Family functioning, as defined by roles, rules, power and flexibility, influences dietary behavior (e.g. vegetable intake). These are discussed separately below.

Roles: Most food preparers, (19/20 female), did most of the shopping, making the associated food choices. Most partners occasionally made trips to the grocery store for small lists (i.e., milk, bread, missing ingredients) in between major shopping trips or accompanied the food preparer to the store at least some of the time (but made few food choices for meals). Most food preparers used a rudimentary shopping list, but they typically shopped based on replacement of a routine food pattern. Meal planning usually was based on the meat choice and an appropriate vegetable followed. Most paid attention to sales or specials and also used coupons. Many chose easy-to-prepare heat and serve frozen vegetables but some indicated a preference for fresh vegetables if affordable. Most food preparers also did the cooking although some partners also prepared occasional meals, for example dinner if the food preparer was away or weekend breakfast. However, one-fourth of the partners either did all of the shopping or shared a substantial portion of the shopping and/or cooking with the food preparer. Children in a quarter of the couples were also involved in meal preparation or shopping on occasion. Food preparers described a range of vegetable use in recipes, but more controls (n=7) than experimentals (n=3) indicated they preferred convenient, heat and serve plain vegetables and did not want to spend much time fixing vegetables.

Couples reported food preparers were expected to prepare foods liked by all or the majority of family members, to put meals together quickly (i.e., 30 minutes) and, for some, to stick to tried and true meal patterns. Some food preparers also felt compelled to offer multiple dishes to please everyone's preferences. Thus role expectations supported limited vegetable choices.

Rules: Although not identified as such, the meal pattern of meat, potatoes/starch and vegetable was a rule that was seldom challenged. Few couples had the food tasting rules and teamwork needed to get new foods on the table. Three couples (n=2 experimental; n=1 control) reported no rules for tasting foods. The remaining couples claimed to have a rule for familiar or new foods – that the child at least taste them. But the rule was generally ignored. About half of the couples recognized the need to teach children to eat healthfully, sometimes through partner role modeling. But only three couples (n=1 experimental; n=2 control) worked as a team to introduce new foods to a picky child or encourage a picky child to eat foods presented at family meals. A parent-child coalition to support eating something not liked by others was reported in only 1/4 of the couples.

Power: The following questions ascertained who had the most power or influence over vegetable choices (i.e. preference power hierarchy) for family meals: *How much influence do you feel you have on the choice of foods/vegetables served at family meals? Whose food likes and dislikes mainly determine what is served? If you liked a vegetable and your partner/children did not like it, how would it affect what is offered at dinner?* In 2/3 of the families the partner or the children could veto serving of vegetables they disliked and thus narrowed vegetable choices at family meals. The food preparer then only served vegetables from the restricted universe liked by most everyone. This pattern was reinforced by repeatedly serving vegetables everyone would eat, rather than making what the food preparer desired or felt was more healthful. In the remaining 1/3 of the families either the food preparer or the parents together (50:50) reported having the most influence on vegetable choices.

*Flexibility***:** About half of the families reported very rarely trying new vegetables. 'New' recipes used in these families generally combined already familiar ingredients including vegetables.

To estimate flexibility, or willingness to incorporate new vegetables into meals, participants were asked: *How willing are you/your partner/your child to change what is served at family meals? For example, serving more spinach or kale on a rotating basis?* Spinach and kale were given as examples because they were relatively mild tasting vegetables highlighted in the lessons that were anticipated to be new to many. Willingness to incorporate spinach or kale into family meals was greater in one parent than the other in about half of the couples. The less willing parent in these couples was often picky and content with their pattern of tried and true vegetables; in other cases the less willing parent was a food preparer who did not know how to fix these greens. A few couples were highly positive because they already ate the examples or saw ways to incorporate them into salads. Most were not familiar with kale, were not sure if they would like it and reported that their children would object to incorporating new vegetables like spinach or kale into meals.

Dietary Behavior (Dinner Meal Pattern)

Role expectations and the vegetable preference power hierarchy affected vegetable variety. Food preparers made choices when food shopping keeping family member vegetable preferences in mind. Vegetables served at dinner reflected generally what everybody would eat most commonly corn, green beans, carrots, salad and broccoli. Some food preparers made vegetables that were well liked, such as broccoli, repeatedly during a week. A control partner explained that he would rather have his children eat broccoli four times a week than no vegetable at all. Another experimental food preparer kept her pantry stocked with canned peas as a back up for anytime her children disliked a vegetable served at a family meal.

Food preparers commonly catered to picky family members, making extra dishes or even two separate meals or tweaking recipes to reflect family preferences. For example, one experimental food preparer served shredded cabbage three different ways to please different children (with mayonnaise, with vinegar, plain) and also kept the broccoli stems and florets separate because each was liked by different children. Only 1/3 of food preparers made what they liked or thought was important, and then often accommodated children by giving them other options. Among those seeking convenience, vegetable presentation was often plain (with maybe butter, salt and/or pepper).

Impact Evaluation

RE & SE

The number of food preparers in each RE stage did not change significantly over time by treatment (data not shown). However, LMM analysis revealed a nearly significant trend ($p=0.062$ for group*time interaction) for experimental partners to move into a more advanced stage over time compared to the controls, who tended to move to a less advanced stage. Only half (48%) of experimental partners were in the action or maintenance stages at baseline, but 77% were by 3-month follow-up. Among control partners, 84% were in action or maintenance at baseline, but only 68% were by 3-month follow-up (see Table 3-5). Mean SE scores as assessed by LMM remained high among experimental and control food preparers with no significant change (data not shown).

Vegetable-Liking

As at baseline, liking scores for the deep orange and cruciferous vegetable groups were higher than for the dark green leafy vegetable group (data not shown) for both partners and food preparers regardless of treatment. Among these target vegetable groups, LMM analysis revealed only a significant positive time effect (p=0.023) for reported cruciferous vegetable group liking scores among partners in both treatments. Average partner responses corresponded to 'like' at baseline (3.9±0.7) through post-test (4.0±0.7) and 3-month follow-up (4.1±0.7).

Perceived Disease Risk and Influence of Vegetables Thereon

There was a significant group by time interaction among food preparers for perceived cancer risk (p=0.008 for group*time interaction) such that experimental food preparers perceived significantly greater personal cancer risk at 3-month follow-up (mean=3.2±1.3, corresponding to 'not sure' in response to: "I am at risk of developing breast, prostate or colon cancer") compared to control food preparers (mean=2.3±1.2, corresponding to 'disagree'; t=2.560; df=42; p=0.014)). There were no significant changes in perceived influence of vegetables on disease risk.

Target Vegetable Intake

Food Preparers

DHQ: DHQ derived total vegetable intake at 3-month follow-up was 13.20±8.55 and 13.46±6.60 cups/week for experimental and control food preparers, respectively (Appendix F).

The group by time interaction was not significant nor were intakes by treatment significantly different.

LMM results in Table 3-6a show a significant positive time effect by 3-month follow-up for vegetable intake in both treatments as assessed by the DHQ for the total deep orange vegetable group, as well as the two clusters examining total target minus carrots/broccoli/lettuce (‘total-C,B,L’) and ‘total in recipes.’ There were significant group by time effects for squash/pumpkin and cauliflower/Brussels sprouts. For squash/pumpkin, only experimental intake increased significantly between baseline and 3-month follow-up (p=0.000), although experimental versus control intake at 3-month follow-up was not significantly different. For cauliflower/Brussels sprouts, there was a significant increase of experimental intake from baseline to 3-month follow-up (p=0.007) while control intake did not change. Although control intake of cauliflower/Brussels sprouts was significantly higher at baseline, mean intake values for both treatments at 3-month follow-up no longer differed significantly. There were no significant time or group by time effects for the total cruciferous or dark green leafy vegetable groups, although there was a significant positive time effect for cooked greens.

VIA: LMM results in Table 3-6b show a significant time effect for food preparer vegetable intake assessed by the VIA. Both treatment intakes for the total deep orange and dark green leafy vegetable groups, as well as the three clusters of the target vegetables (total target, ‘total-C,B,L’ and ‘total in recipes’) increased over time. Patterns of change indicated increased intake of carrots especially by controls and dark lettuce and raw greens especially by experimentals contributed to this change over time. There was a significant group by time effect for intake of raw greens. Only control intake increased significantly between baseline and post-test (p=0.008) but only experimental intake increased significantly between baseline and 3-month follow-up (p=0.031). There was no significant difference between treatments in mean intake values at any time point. Although there was no significant time effect for total cruciferous intake, there was for cauliflower/BS. However, the major contributor to increased intake especially in controls was broccoli. While not significant by treatment, the mean intake of the three target vegetable clusters increased consistently over time for experimentals while in controls intake decreased at 3-month follow-up.

Partners

LMM results in Table 3-6c show that partner vegetable intake assessed by the VIA in both treatments changed significantly over time for the total deep orange, cruciferous and dark green leafy groups as well as the three clusters of target vegetables but changes did not differ between experimentals and controls. Experimentals made greater changes in carrots (and hence deep orange total) while controls made greater changes in dark lettuce (and hence dark green leafy total). Broccoli also contributed to change in both treatments. Similar to the pattern seen for food preparers, there was a tendency over time for experimental partner intake of the three target vegetable clusters to increase and remain high while control intake decreased at 3-month follow-up.

Characteristics of Family Meals

There was a significant group by time interaction for number of shared family meals reported by both food preparers and partners (Tables 3-7a and 3-7b). Both adults reported similar and consistent number of meals per week but only in control families did number of meals decrease significantly between baseline and post-test (food preparers (FP): p=0.032; partners (P):

p=0.000) and between baseline and 3-month follow-up (FP: p=0.005; P: p=0.009). Number of family meals were significantly different by 3-month follow-up between food preparer (t=2.352; p=0.023) but not partner treatments.

Food preparers did not report any significant changes in frequency of serving deep orange or cruciferous vegetables over time (Table 3-7a). But regardless of treatment, food preparers did report increasing the frequency of serving both cooked and raw greens (and hence dark green leafy total). In addition, regardless of treatment, food preparers reported increased serving of the three clusters of target vegetables. While not significant by treatment, changes in reports of serving vegetables featured in recipes suggested that the experimentals continued to serve these while control use of target group recipes dropped off.

In contrast, partners in both treatments reported consistent increases in frequency of serving the total deep orange, cruciferous and dark green leafy groups as well as the three target vegetable clusters at dinner over time (Table 3-7b). Partners reported an increase in dark lettuce and raw greens were the contributors to increase in the dark green leafy group (in contrast to cooked and raw greens by food preparers). There was a significant group by time effect for serving of raw greens. Only control partners significantly increased reported serving of raw greens at post-test (p=0.039), however this decayed at 3-month follow-up while experimental partner reporting of raw greens increased significantly (p=0.052) between post-test and 3-month follow-up. Reported frequency of serving raw greens did not differ by treatment at any time point. While not significant by treatment, control partners reported less serving of vegetables in recipes at 3-month follow-up than experimental partners, a pattern also reported by control food preparers.

Subset Analysis without Baseline Extreme Outliers

When the 7 outliers were omitted from the VIA and DHQ data sets, LMM analysis of personal intake and frequency served of the total deep orange, cruciferous and dark green leafy groups as well as the three target vegetable clusters revealed that p-values for group by time effects tended to decrease among food preparers and increase among partners but did not reach significance. This subset of outlier food preparers and partners reported higher baseline personal intakes and frequency of serving of the target vegetables than those not omitted and 6/7 were in action or maintenance stage of RE at baseline. Outlier food preparers had more children at home (average of four children) and higher SE scores than the other food preparers. Other demographic differences were not seen among outlier versus ‘normal’ partners.

Nutrient Intake & Steps for Food Preparers

Of the nutrient intake assessed from the DHQ (Table 3-8), intake of vitamin A and carotene both improved by 3-month follow-up but the group by time interaction was not significant. There was a nearly significant trend for calorie intake to decrease over time. There was also a non-significant trend among experimental food preparers to increase daily step equivalents from baseline through 3-month follow-up compared to the control treatment. However the percentage of controls reporting this data were only 40, 30 and 21% of experimental numbers at baseline, post and 3-month follow-up respectively.

Recipe Use

At 3-month follow-up, experimental food preparers had made vegetable recipes in all categories more often than controls (Figure 3-3). This was significant for the cruciferous recipes and nearly significant for the total of all recipes ($t=1.893$; $p=0.069$). This agrees with the trend discussed above for the experimentals continuing to serve vegetables featured in recipes at 3-month follow-up while control use of vegetables in recipes declined.

Process Evaluation

Out of 25 experimental food preparers, 17 (68%) attended all eight lessons, three attended six or seven lessons, two attended one lesson and three did not attend any lessons. Dose, or number of classes attended, was significantly and positively correlated with increase in total target vegetable intake (3-month follow-up minus baseline) for experimental food preparers ($r=0.501$; $p=0.018$), but not partners ($r=0.349$; $p=0.111$).

Meal Diaries

Experimentals had significantly ($t=3.557$; $p=0.001$) higher family meal diary scores (average score = 6.7 ± 5.3) compared to controls (2.2 ± 3.5), meaning that more recipes were tasted/eaten by both parents and at least one child. Fifteen experimental families had meal diary scores of at least seven (i.e., parents and a child tasted/ate seven or more recipes) while only 3 control families reported this. When experimental and control families were placed in low (0-6) and high (7-15) meal diary score groups and change in parental vegetable intake was examined for each meal diary grouping, higher family meal diary scores were associated with greater intake of target vegetables by both adults (see Table 3-9 and Figures 4a-4d).

Experimental food preparers in the high-score group made significantly greater improvements in total target, ‘target –C,B,L’ and ‘total in recipes’ vegetable intake compared to experimental food preparers in the low-score group. Both group by time interactions and t- tests comparing values at 3-month follow-up or both post assessments were significant (Figure 3-4a, Appendices J & N). There were also significant group by time effects for experimental partner intake of total target and ‘total in recipes’ vegetable intake. Only experimental partners in the high-score group increased intake significantly from baseline to posttest (total in recipes (tr): p=0.029) and/or baseline to 3-month follow-up (total target: p=0.003; tr: p=0.007). However, mean partner intake values at post assessments were not significantly different between high- and low-score groups (Figure 3-4b, Appendix O).

Comparing control high- and low-score groups, significant time effects, but no significant group by time effects were found for food preparer and partner intake of any of the three target vegetable clusters. In contrast to those in the experimental high-score group, any increased intake achieved at post-test by those in the control high-scoring group decayed at 3-month follow-up (Figures 3-4c & 3-4d, Appendices L, M, P, Q).

These trends were verified for food preparers using DHQ derived vegetable intake data (Table 3-10, Appendices R-W). Among experimental food preparers, the group by time interaction for ‘total-C,B,L’ was again significant and for ‘total in recipes’ was nearly significant. T-tests indicated values for both of these vegetable clusters (as well as for total target vegetables) were significantly greater at 3-month follow-up among the high- versus low-score group. There were no significant time or group by time effects in control food preparer DHQ derived intake for any of the three target vegetable clusters for the high- versus low-score groups indicating no significant changes in intake.

Number of times target vegetables were served at family meals was also assessed by low versus high meal diary score for food preparers and partners (Table 3-11, Appendices X-II). For experimental food preparers, significant group by time effects were found for ‘total-C,B,L’ and ‘total in recipes’ vegetable intake, with intake at both post-test assessments significantly higher among high- versus low-scorers (Appendices BB & FF), also seen for total target vegetables (Appendix X). Those in the high-scoring group increased times served at post-test and retained this increase at 3-month follow-up while times served among those in the low scoring group changed minimally. Similar patterns were seen for experimental partners, but with more variation (Appendices Y, CC & GG). Only experimental partner’s serving of total target vegetables showed a significant time effect. There were significant time, but not group by time, effects for control food preparer and partner reports of serving of the target vegetable clusters. Similar to VIA derived intake data for controls, any increased serving achieved at post-test among those in the high-scoring group generally decayed by 3-month follow-up (Appendices Z (this one does not decay), AA, DD, EE, HH, II).

Total recipe use at 3-month follow-up, as defined in the footnote to Figure 3-3, was significantly higher among experimental food preparers in the high- versus low-scoring group ($t=-4.377$; $p=0.001$). Experimental food preparers in the high-score group prepared an intervention recipe on average 6.73 ± 5.96 times between post-test and 3-month follow-up while those in the low-score group did not prepare any recipes within that same time frame.

Experimental participant demographic and baseline characteristics (readiness-to-eat more vegetables, self-efficacy, vegetable-liking, number of family meals) for high- and low-scoring groups were compared (Tables 3-12 & 3-13). Those in the high-score group were more likely to be married, to have lived with their partners for a greater number of years and have higher incomes compared to those in the low-score group, although only marital status was significantly different. Such comparisons were not pursued with controls because of the imbalanced numbers in high- and low-score groups (N=3 and 22, respectively).

Focus Groups

The twenty experimental food preparers who participated in the focus groups (range of 7 to 8 participants/group) reported being unfamiliar with the target vegetables, especially the dark leafy greens, initially not knowing how to prepare them and would have been unlikely to try as many target vegetables if just given printed recipes. They liked the meetings' friendly social environment, the 'hands on' experience of recipe preparation, and the opportunity for their families to taste them. They also liked cooking as a group ("It was like a girls' night out.") and having multiple meeting times each week from which they could choose to attend. They disliked keeping step logs and would have preferred pedometers for tracking their activity. Prior to enrolling, several food preparers secured family agreement to be involved and in turn felt they had more success with family recipe tasting. Some children were excited about the weekly recipes ("Even if there was something that they didn't like or whatever, they looked forward to what's it going to be."). Cruciferous vegetables, salads and sweeter vegetable dishes were generally more acceptable than those using savory dark leafy greens. Participants suggested providing additional print recipes with each lesson so that a vegetable in an unsuccessful recipe could be retried in another way.

Follow-Up Couple Interviews

Personal Characteristics

Member Vegetable Preferences:

Experimentals (n=9) - Although sample picky prevalence did not change, vegetable preferences were expanded within seven couples where partners or children accepted a previously disliked vegetable (Brussels sprouts, cauliflower, squash) in an intervention recipe. Three food preparers had subsequently repeated the newly accepted vegetable recipe. Some partners were also pleased to have vegetables they ate when younger reintroduced (i.e., Brussels sprouts, greens). One couple requested more savory orange vegetable recipes.

Controls (n=7) - Interviewees reported no changes in family members' vegetable preferences or number of picky members. Food preparers only made intervention recipes if they featured familiar vegetables their family members already ate. However, the partner and children in one family discovered a previously disliked vegetable (Brussels sprouts) was palatable in an intervention recipe and the food preparer claimed she would probably serve it again.

Self-Efficacy:

Experimentals - Seven food preparers enjoyed learning new skills i.e., preparing savory dark leafy greens for cooking. Five appreciated learning what the family liked and disliked. Two food preparers felt just making the recipes represented success (n=2; i.e., they would not have prepared the recipes otherwise) while two partners said the supper club helped the food preparer become more experimental (n=2). One food preparer tried eating more salads before dinner, but stopped because it reduced her appetite for the rest of the meal (a desired outcome that would have lead to decreased calorie intake). Two food preparers who did not repeat any intervention vegetable recipes were more interested in the experience and skills than new recipes. However all couples valued the experience of trying new dishes and being introduced to the variety of vegetables and cooking methods available.

Controls - Food preparers discarded recipes because they a) did not know how to prepare some of the featured vegetables (i.e., savory greens) or how they would taste (n=4), b) were unwilling to buy the fresh vegetables when they would likely go bad when not used (n=3), and c) were unwilling to allocate food dollars to an ‘iffy’ product (n=1).

Family Food System

External Food System:

Experimentals & Controls - There was a seasonal change in the types of stores used. Because the interviews were conducted in early spring, and couples could not visit farmer’s markets, they were now obtaining all of their vegetables from grocery and big box stores.

Internal Food System:

Experimentals - Family meal frequency and member attendance was the same for most families although a few had changed frequency and attendance for work or schedule reasons. The intervention inspired double the number of couples (n=8 versus n=4 at baseline) to plan gardens, or at least potted vegetable plants, in the upcoming year. Three of these couples wanted to plant more dark leafy greens.

Controls - Frequency of family meals was the same for three couples, increased for one couple due to the purchase of a slow cooker and decreased for three couples due to work or child activity schedules. Members present for family meals generally stayed the same. All couples with gardens at baseline (n=4) planned to plant gardens again, and one planned to grow the savory greens. One couple with no garden at baseline was planning one for the upcoming year.

Family Functioning

<u>Roles</u>:

Experimentals - Eight food preparers (8/9 female) still did the majority of the shopping and cooking, although the partner in one couple was doing less cooking than at baseline. The remaining couple continued to share chores. Most food preparers accepted the role of change agent but met established *role expectations* by repeating, or intending to repeat, recipes that matched current member preferences, received positive family member reviews or were eaten when brought home during the supper club. Five food preparers repeated at least one vegetable recipe at home (range one to eleven), and three food preparers made two to five of the vegetable recipes two to four times each. Two intended to use stealth, i.e., adding greens to soups or stir-fries, to introduce vegetables not getting enthusiastic reviews. However, three food preparers were disinterested in recipes preferring to continue heating and serving plain, convenient vegetables that already satisfied their family.

Controls (n=7) - Shopping and cooking roles remained the same in five couples. In the other two couples, partners shared more of the shopping and/or cooking with food preparers compared to baseline. Five food preparers did report making some of the intervention vegetables recipes. However, the mailed material failed to inspire five food preparers, including three who had made a few intervention vegetable recipes, to become change agents. They remained only interested in heating and serving their current repertoire of vegetables with no interest in further use of the intervention recipes. These five eliminated the intervention recipes using pre-screening rules that were based on both personal and family preferences. To meet personal preferences about work, food preparers rejected recipes based on ingredients (not in the house or personally unfamiliar, i.e., collards), multiple steps (i.e., cooking rice then combining with greens), and need to wash and chop vegetables. They explained their preference for convenience by citing the need to get dinner together quickly and even a simple recipe was not quick. Some also eliminated recipes with any ingredients not liked by family members or any containing a vegetable for which they already had a recipe liked by the family (matching both role expectations and personal work ethic). The two remaining food preparers were open to experimenting with new vegetables and techniques and reported trying several of the recipes. However, one carefully screened recipes so their ingredients matched what all the family liked thus fulfilling role expectations.

Rules:

Experimentals - Key family meal components were still meat, potato/starch and vegetables. However, compared to baseline, three couples now indicated rules that children taste and eat something were enforced for a) all dishes brought home from the supper club; b) foods liked in the past; or c) salads.

Controls - The unspoken rule for meat, potatoes/starch and vegetables remained unchallenged at family meals. There were no detectable changes from baseline in food tasting rules.

Power:

Experimentals - Family members' power over vegetable choices was reevaluated based on reasons given for or against making supper club recipes at home. Among experimentals at baseline, partners and children's preferences dominated vegetable choices in five couples while the food preparer or both parents appeared to have the most influence on vegetable choices in four couples. At follow-up, in two of these four couples, either the children's preferences or the male partner's preferences were revealed as the bottom line. So partners' and children's preferences controlled vegetable choices in the majority of these families.

Controls - Food preparers' reasons for eliminating recipes in the intervention packet allowed a reassessment of whose preferences determined vegetable choices. Four food preparers eliminated recipes that did not meet first the partner's (most important) and then children's preferences, despite two food preparers having claimed to control vegetable choices at baseline. Two food preparers ignored their partners and used just the children's preferences to screen recipes, indicating the children's preferences were the bottom line despite parents claiming to control vegetable choices in these families. In the remaining couple, all recipes were rejected due to the food preparer's school commitments although her partner remained the determinant of vegetable choices. Thus partners and children's preferences dominated vegetable choices in these families.

Flexibility:

Experimentals - In three couples, both parents were enthusiastic about adding new vegetables twice a month or having more of the emphasized vegetables on a rotating basis at family meals. In one other couple, although the partner was willing to incorporate new vegetables, the food preparer was more positive than the partner because she liked more of the target vegetables than he did. Four of the five remaining partners were generally enthusiastic (one partner who liked plain vegetables tried only a few dishes and was generally unenthusiastic). However these five food preparers were less so due to time pressures (n=4) and work involved (n=2) and disinterest in doing more than heating and serving (n=2). Two of these couples were already making changes in vegetables served despite food preparer hesitancy, but the other three seemed unlikely to make substantial changes. One of these food preparers admitted that class was motivating but implementing changes at home was more difficult.

Controls - In five couples, food preparer disinterest (n=4) or both partners' disinterest (n=1) eliminated willingness to change vegetables at family meals, despite the mailed information (some food preparers did not read any mailed material except the recipes). Among these five, two food preparers made no *vegetable* recipes and the others tried one to four vegetable recipes. In only two couples, where both parents were open to trying new vegetables, food preparers did try six to ten of the vegetable recipes. However, children were excited about tasting new dishes in only one of these couples.

Dietary Behavior (Dinner Meal Pattern)

Experimentals - The supper club affected what was served at dinner, often in multiple ways. Six couples were working new vegetables into current recipes or preparation patterns, for example adding collards to stir-fries or kale to salads. Five food preparers said they had repeated or planned to repeat intervention recipes with small modifications (i.e., omitting the garlic or tomatoes) and another five were serving more of the vegetables they already ate (i.e., more salads or serving two vegetables instead of one). One couple increased vegetables in lunches. The most popular recipes were for roasted cauliflower, several salads, and a soup using savory greens. The deep orange vegetable recipes were least popular, as only two food preparers repeated one of those.

Controls - Dinner meal patterns were similar to those reported at baseline. Two couples were now cutting back on processed meat intake for the family or just the children. Only one couple reported eating fewer vegetables due to their cost, but even so tried more vegetable recipes than the other couples. There was little change in terms of vegetables served, with the exception of any vegetable recipes tried by the food preparers. The most popular recipes were for sweet potatoes, roasted cauliflower, several salads, and a one-pot meal using spinach. The savory dark leafy green recipes were least popular as only one food preparer reported trying one of these recipes.

Participant Opinions about Supper Club

Experimentals (n=9) - Both parents (n=6), the food preparer (n=1) or the partner (n=2) had positive views about the supper club. In six of these couples, parents reported children were also positive about the program and looked forward to the weekly dishes. Five of the couples believed that completing the meal diaries improved their efforts to get more or new vegetables on the table. It held family members accountable for trying the dishes and providing their opinions. In fact, the one interviewed experimental family with a *low* meal diary score (defined as both parents and a child tasted or ate only six vegetable recipes or fewer) did not repeat any vegetable recipes after the supper club and was among the three couples judged unlikely to make any changes to vegetables served (discussed within flexibility). Among the eight experimental families with *high* meal diary scores (defined as both parents and a child tasted or ate at least seven vegetable recipes), six were already repeating vegetable recipes or otherwise making positive changes in vegetables served. The major suggestion for improving the intervention was to provide more recipes, perhaps on a web page. However, one food preparer did not want more as she felt the number offered was overwhelming.

Controls (n=7) - Couples were asked what would improve the intervention material. All seven said attending the weekly group sessions, which would have forced them to make the recipes and serve them to their families. Four food preparers said learning preparation skills and tasting samples could have inspired making the recipes. Three couples suggested print material should designate days of the week to prepare the recipes to serve as both a reminder for the food preparer and to alert the family to ‘new vegetable’ night. Other suggestions focused on money (bribes to kids (n=1), coupons (n=1), or a debit card for purchasing ingredients (n=1)). Although control couples did not mention any benefits resulting from completing the meal diaries during their interviews, the two interviewed control families with *high* meal diary scores made more of the intervention vegetable recipes (range six to ten) than those with *low* meal diary scores and were among the three food preparers to repeat recipes more than once.

Discussion

This eight-week, theory-based wellness intervention for low-income, rural Appalachian families had two unique features: a) a focus on increasing intake of the deep orange, cruciferous, and dark green leafy vegetables; and b) examination of the intervention impact on both the participant food preparer and their adult partner. Although multiple theories were used in the development and analysis of this intervention (Social Cognitive Theory, reciprocal determinism model, Circumplex Model of Marital and Family Systems), the reciprocal determinism model provided the most comprehensive framework and will be used to frame this discussion (see figure 3-1).

Family Food System

Interviews revealed that experimental couples especially experienced increased interest in gardening and growing the dark leafy greens. Growing vegetables in home gardens can alleviate availability issues and encourage more vegetable experimentation.

Personal Characteristics

Based on use of Social Cognitive Theory (SCT) in its design, the intervention was expected to affect self-efficacy and readiness-to-eat more vegetables. At baseline both experimental and control food preparers reported high self-efficacy scores and these scores did not change post-intervention. In post-intervention interviews, experimental food preparers reported skill and knowledge changes that indicated great increases in self-efficacy while controls interviewed reported lack of skills and the need to taste a recipe prior to serving it limited their ability to make use of the print material. This discrepancy reflects the general nature of the self-efficacy scale, which although validated, was not specific enough to detect quantitative change in SE about our target vegetables. Thus while the intervention likely altered self-efficacy of experimentals, self-efficacy of control food preparers remained a barrier to change. Other researchers have similarly found lack of skills or self-efficacy to impede food choice change

(Hartman et al., 1994; John & Ziebland, 2004; Maclellan et al., 2004; McGee et al., 2008; Reicks et al., 1994; Treiman et al., 1996).

RE similarly changed little among food preparers, likely because about 90% were already in the action and maintenance stages at baseline. However, experimental partners reported progressing into more advanced RE stages at post-intervention assessments compared to controls, who regressed to less advanced RE stages by 3-month follow-up. Thus, the experience of having new vegetables appear at the family table, a unique feature of this intervention, appeared to affect some experimental partners. This RE shift was not associated with a significant change in experimental partner target vegetable intake, perhaps because the validated readiness-to-eat form asked about vegetables in general, i.e., generic, as opposed to the specific target vegetables. However, De Vet et al. (2005) cautions against using stage-of-change when evaluating an intervention based on their finding that people often spontaneously changed stage-of-change for fruit intake even when evaluations were done in close proximity to each other.

Family Functioning

According to Family Systems Theory, altering family flexibility requires changes in roles, rules and/or power. Among couples interviewed, vegetable preference power hierarchy (ability to determine vegetables served) did not change. The preferences of partners and/or children continued to determine dinner vegetable choices, despite some food preparers originally claiming the ability to ignore this and make their preferred choices. Food preparers continued to fulfill *role expectations* by preparing those vegetable dishes family members would like, in agreement with other studies finding the norm is to please the husband and/or child (DeVault, 1987; Kerr & Charles, 1986; Pill & Parry, 1989; Stratton & Bromley, 1999).

The intervention encouraged food preparers to take on the *role* of change agent, but some, especially among controls, refused to accept this role. Controls who declined used extensive pre-filtering rules to reject recipes offered. They plus a few experimental food preparers preferred to retain their current heat and serve pattern, despite the experimental intervention introducing less expensive heat and serve vegetables and providing tips for adding these to other dishes. Although time and effort have been cited as barriers to changing food choices (Hampson et al., 2009; Hartman et al., 1994; John & Ziebland, 2004; Maclellan et al., 2004; McGee et al., 2008; Reicks et al., 1994; Treiman et al., 1996), our interviews revealed disinterest in the lesson objectives at baseline, suggesting our generous incentives were the reasons for some volunteering to participate.

Experimental food preparers were encouraged to establish tasting rules for the vegetable dishes. Post-intervention couple interviews indicated that a few experimental families established firmer tasting rules for children. There is a positive correlation between enforced family rules for tasting and eating vegetables with children's actual vegetable consumption (Vereecken et al., 2005).

Thus interviews indicated that most control and some experimental families reported few changes in roles, rules and decision–making power around vegetable choices, leading to little overall flexibility to change vegetables offered at family meals. However, families with high meal diary scores appear to have adopted a 'process' that involved communication with family members, which may have increased flexibility. During couple interviews and focus groups, some experimental food preparers reported taking responsibility of completing this instrument (having to report back at the next meeting was motivating) and negotiated or secured family member involvement with tasting and evaluation of recipes, a few even prior to starting the lessons. From this process emerged suitable recipes (as is or modified) or ways to use the particular vegetables in other recipes. Methods of encouraging intra-family negotiation are not typically included in nutrition interventions that target the female food preparer. This intervention and others demonstrate that just providing the necessary knowledge and skills do not enable most to instigate change. More experimental than controls families appeared to use the meal diary as an evaluative tool suggesting it use would benefit future interventions targeting the food preparer.

Dietary Behavior

The experimental supper club eliminated the commonly cited barriers to altering food choices by providing food preparers with skills, familiarity, knowledge and access to the target vegetables while highlighting ways to minimize cost, time and effort. This intervention was distinct in that it provided food preparers with actual prepared vegetable dishes, which gave the whole family a chance to taste them and allowed us to study the intra-family factors affecting adoption. If only ingredients and recipes were provided, some food preparers would have pre-filtered based on his or her own assessment of the dish and instead used only the familiar ingredients in already familiar dishes (even if he or she tasted the dish prior to taking the ingredients home) instead of preparing and serving it to see how the family reacted. Little change in family food habits would likely be observed.

Despite some significant time effects, only a few significant, but very small differences in target vegetable intake and frequency of serving these vegetables resulted between the original experimental and control treatment groups. Partner reports usually mirrored those of the food preparers with sometimes greater variance, perhaps reflecting a differential effect on partner awareness of what was served provided by participation in the study. Correlations of food preparer and partner intake of the vegetable groups were modest and ranged from 0.231 to 0.338, suggesting that the intake of one partner explained only 5-11% of the variance in the other partner's intake for that group.

Both treatments produced increases in reported target vegetable intake and serving over time, suggesting that the process of filling out the instruments produced a Hawthorne effect, or "the tendency of study participation per se to affect the outcome" (Kramer, 1988). One interviewed control participant indicated just completing the questionnaires increased her awareness of the need to increase family vegetable intake. When increases were reported, it was generally for those vegetables participants already ate and served (carrots, broccoli, and dark lettuce), suggesting intra-family dynamics were still a major barrier to change. Using repeated 24-hour recalls to assess target vegetable intake may have resulted in less social desirability bias than the VIA and DHQ. Additionally, a larger sample size may have been able to detect a significant intervention effect.

However, when families were grouped by high and low meal diary scores, high scores were associated with significant and sustained change in food preparer (and to some extent partner) intake and frequency of serving the target vegetables in those families. The net difference (3-month follow-up minus baseline for each group) in total target vegetable intake between experimental food preparers in the high- and low-score groups was 3.9 cups/week at 3-month follow-up (equivalent to 0.6 *cups/day* or 1.1 *servings/day*, assuming 2 servings per cup). This is greater than in other interventions that have found net increases in total vegetable intake for experimental versus control groups of 0.5 servings/day (i.e., a quarter cup per day, assuming 2 servings per cup) (Resnicow et al., 2001; Resnicow et al., 2004). Additionally, these other interventions promoted and reported on all vegetables, while the current 8-week intervention targeted the less familiar protective vegetables. Five times more experimental families (15/25) than controls (3/25) had high meal diary scores.

Other Noteworthy Points

Daily step equivalents increased modestly among experimental but not control food preparers (Table 3-8). However, there was great variance in this data and the number of controls returning step logs was low. Participants disliked keeping step logs and we found calculating step equivalents from reported activities challenging. Pedometers would have facilitated the process for both participants and researchers but budget restrictions prevented offering these to participants. Incorporating pedometers in a walking program can increase activity of previously inactive adults (Merom et al., 2007).

Number of classes attended was significantly correlated with increased total target vegetable intake among food preparers, although dose only explained 25% of the variance in their total target vegetable intake. Others have similarly found attendance to be positively related to increased fruit and vegetable intake (Havas et al., 1998; Havas et al., 2003), although these two studies did not determine correlation coefficients and so we are unable to compare the size of our correlation directly with theirs.

Analysis of both the DHQ and VIA produced similar patterns of food preparer target vegetable intake. Correlation coefficients also indicated relatively good agreement between the two instruments. To establish relative validity of a FFQ by correlating results with a gold standard (i.e., food records), Spearman correlation coefficients should be above 0.5 for nutrients of interest (Masson et al., 2003). Since correlation coefficients in our study were 0.6 or better for the 8/10 questions taken verbatim from the DHQ, this suggests the ability of the VIA to measure intake is sufficiently similar to that of the DHQ to establish patterns of intake. However, comparing VIA intake estimates with food records or 24-hour recalls would be necessary to establish its true validity as a short measure of specific vegetable intake. Some disagreement between the instruments should be expected, as the DHQ assessed intake over the previous 6 months while the

VIA assessed intake over the previous month. The third data point provided by the VIA was valuable and reduced participant fatigue.

This study had limitations. It used a small, self-selected sample that provided self-reported measures, although this is typical of community-based intervention studies. Quantitative data collection and couple interviews were conducted by the same researcher that delivered the intervention, potentially increasing socially desirable responses. It also attracted many parents with picky family members and food preparers with higher total vegetable intake than the national average. Our sample consumed on average over 13.5 cups of vegetables/week (excluding legumes) at baseline, which is near the 14.5 cups/week (excluding legumes) recommended by the Dietary Guidelines for Americans (US Department of Health and Human Services and USDA, 2005) and less than seen in other studies that have estimated US adult vegetable intake (*including* legumes) at 7 to 12.6 cups/week (14 to 25 ½-cup servings/week) (Casagrande et al., 2007; Guenther et al., 2006; Johnston et al., 2000; Kimmons et al., 2009). However our participants, like most Americans, did not consume the variety of vegetables recommended at baseline. Nevertheless, this study also had substantial strengths. It was theory-driven, had a randomized control evaluation design with repeated measures, and it included impact and process evaluation measures that collected outcomes for and perspectives of both food preparers and their partners.

Conclusions

In addition to eliminating many of the frequently cited barriers to altering food choices, this intervention was unique in that food preparers left meetings with actual prepared dishes (as opposed to just ingredients and recipes), which facilitated family members at home tasting the dishes. Feedback on this process helped us understand the intra-family factors that impacted acceptance of the vegetables. There were few significant differences between original experimental and control treatments in target vegetable intake and frequency of serving, suggesting that offering the critical knowledge and skills to food preparers is not enough to change family food choices. Couple interviews revealed that most control and some experimental families reported few changes in roles, rules and power over vegetable choices, resulting in minimal flexibility to change vegetables at family meals. However, food preparers in families reporting greater involvement of both parents and children in vegetable dish evaluation through a meal diary had significantly greater increases in intake and frequency of serving of target vegetables than those reporting poorer family involvement. Meal diary utilization was much more prevalent among experimental families and may have fostered food preparer negotiation with family members. Although not usually addressed in nutrition interventions targeting the food preparer, tools to support intra-family evaluation and perhaps negotiation are critical for instigating change in food choice.

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Table 3-1. Social Cognitive Theory constructs, definitions, and examples of application (Baranowski 1997; Baranowski et al. 1997)

Construct	**Definition**	**Examples of application**
Physical Environment	Factors external to a person	Increase the availability of vegetables in the home
Social support	Encouragement received from those close to an individual	Interact with program leader and small groups who get to know each other well at each lesson; encourage family members to taste dishes and provide feedback on them
Expectations	Anticipated behavioral results	Learn the nutritional value and health benefits of vegetables
Behavioral capability	Knowledge and skills necessary to execute a behavior	Gain knowledge on choosing, storing and preparing vegetables; develop skills to prepare vegetables in recipes
Self-efficacy	Self-confidence to enact a behavior	Gain confidence while discussing ways to introduce vegetables to the family and learning to prepare vegetables
Observational learning	Watching other's actions and resulting outcomes	Share ideas for introducing vegetables to the family; watch others fix vegetable dishes
Reinforcement	Positive or negative reactions to one's behavior that influence whether the behavior is repeated	Receive oral compliments on activities/recipe preparation and reinforcement of principles in subsequent meetings.

Table 3-2. Participant demographic characteristics (N=100)

	Experimental (n=50)		**Control (n=50)**	
	Food Preparers (n=25)	**Partners (n=25)**	**Food Preparers (n=25)**	**Partners (n=25)**
Sex				
Female	23 (92%)	2 (8%)	24 (96%)	1 (4%)
Age, y (*mean* $\pm$ *SD*)	43.5$\pm$6.7	45.3$\pm$7.1	43.0$\pm$7.0	45.6$\pm$7.0
Years lived with partner (*mean* $\pm$ *SD*)	17.9$\pm$7.2	17.9$\pm$7.2	17.8$\pm$9.1	17.7$\pm$9.2
Hispanic or Latino	0 (0%)	3 (12%)	0 (0%)	1 (4%)
Race[a]				
White	25 (100%)	23 (92%)	24 (96%)	23 (92%)
Black	0 (0%)	0 (0%)	1 (4%)	1 (4%)
American Indian or Alaska native	0 (0%)	1 (4%)	0 (0%)	0 (0%)
Total	25	24	25	24
Marital status				
Married	22 (88%)	22 (88%)	22 (88%)	22 (88%)
Living with partner	3 (12%)	3 (12%)	3 (12%)	3 (12%)
Others living in household				
Partner or spouse	25 (100%)	25 (100%)	25 (100%)	25 (100%)
Number of children (*mean* $\pm$ *SD*)	2.4$\pm$1.2	2.4$\pm$1.2	2.7$\pm$1.3	2.7$\pm$1.3
Other	2 (8%)	2 (8%)	2 (8%)	2 (8%)
Total in household (*mean* $\pm$ *SD*)	4.5$\pm$1.4	4.5$\pm$1.4	4.8$\pm$1.4	4.8$\pm$1.4
Education level[a]				
High school diploma/GED or less	4 (16%)	5 (20%)	3 (12%)	7 (28%)
Trade or business school	5 (20%)	5 (20%)	5 (20%)	4 (16%)
Some college	8 (32%)	6 (24%)	5 (20%)	3 (12%)
Bachelor’s degree or higher	8 (32%)	9 (36%)	12 (48%)	11 (44%)
Employment status[a]				
Employed	18 (72%)	23 (92%)	17 (68%)	21 (84%)
Unemployed	4 (16%)	0 (0%)	7 (28%)	1 (4%)
Retired	2 (8%)	2 (8%)	1 (4%)	0 (0%)
Other	1 (4%)	0 (0%)	0 (0%)	3 (12%)
Annual household income[a]				
$10,001 to $20,000	3 (12%)	3 (12%)	3 (12%)	2 (8%)
$20,001 to $30,000	3 (12%)	3 (12%)	4 (16%)	5 (20%)
$30,001 to $40,000	8 (32%)	8 (32%)	7 (28%)	7 (28%)
$40,001 to $50,000	11 (44%)	11 (44%)	11 (44%)	11 (44%)
Body Mass Index – self-report (*mean* $\pm$ *SD*)	33.7$\pm$9.1		31.3$\pm$5.6	

[a] For analysis, some response options were combined to minimize the number of cells with expected frequencies of less than five (i.e., race=white/non-white; education level=trade or business school or less/at least some college; employment status=employed/not employed; income=$10,001-30,000/$30,001-40,000/$40,001-50,000).

Table 3-3. Participant baseline characteristics

	Experimental (n=50)		Control (n=50)	
	Food Preparers (n=25)	**Partners (n=25)**	**Food Preparers (n=25)**	**Partners (n=25)**
Readiness-to-eat more vegetables [a,b]				
Pre-contemplation	0 (0.0%)	3 (12.0%)	0 (0.0%)	2 (8.0%)
Contemplation	0 (0.0%)	1 (4.0%)	1 (4.0%)	1 (4.0%)
Preparation	2 (8.0%)	9 (36.0%)	2 (8.0%)	1 (4.0%)
Action	17 (68.0%)	9 (36.0%)	16 (64.0%)	17 (68.0%)
Maintenance	6 (24.0%)	3 (12.0%)	6 (24.0%)	4 (16.0%)
Mean ± Std Dev	4.16±0.55	3.32±1.15	4.08±0.70	3.80±1.04
Self-efficacy [c]				
I feel that I can:	*Means ± Std Dev*			
Buy more vegetables the next time I shop	2.88±0.33	--	2.76±0.52	--
Plan meals with more vegetables during the next week	2.76±0.52	--	2.88±0.44	--
Add extra vegetables to casseroles and stews	2.64±0.64	--	2.84±0.47	--
Eat two or more servings of vegetables at dinner	2.80±0.41	--	2.92±0.28	--
Vegetable-liking [d]	*Means ± Std Dev*			
Deep orange [e]	3.9±0.7	3.8±0.6	4.1±0.6	3.8±0.8
Cruciferous [f]	4.2±0.6	3.9±0.7	4.1±0.6	3.8±0.6
Dark green leafy [g]	3.4±0.7	3.2±0.7	3.3±0.6	3.3±0.7
Number of family meals/week	*Means ± Std Dev*			
	5.6±1.6	5.3±1.7	5.6±1.4	5.7±1.4
Frequency served at meals (x/week)	*Means ± Std Dev*			
Carrots	0.89±1.29	0.83±0.98	1.23±1.34	0.64±0.58
Squash/Pumpkin	0.06±0.17	0.07±0.17	0.02±0.06	0.07±0.13
Sweet Potatoes	0.16±0.30	0.10±0.19	0.24±0.44	0.16±0.26
Deep orange total	1.11±1.25	1.00±0.97	1.48±1.63	0.87±0.75
Broccoli	0.95±0.95	1.11±0.95	1.27±1.11	1.00±0.96
Cabbage/Sauerkraut	0.17±0.25	0.33±0.56	0.24±0.42	0.20±0.41
Cauliflower/Brussels sprouts	0.34±0.45	0.26±0.42	0.42±0.48	0.35±0.44
Cole Slaw	0.20±0.21	0.12±0.19	0.34±0.67	0.24±0.41
Cruciferous total	1.65±1.15	1.81±1.21	2.27±1.95	1.79±1.51
Cooked Greens	0.37±0.76	0.44±0.83	0.16±0.41	0.23±0.45
Dark Lettuce	1.03±1.33	0.87±1.23	1.44±1.21	1.04±1.18
Raw Greens	0.43±0.82	0.31±0.76	0.24±0.70	0.15±0.30
Dark green leafy vegetables total	1.83±2.15	1.62±2.46	1.84±1.71	1.41±1.54

[a] There is a significant difference between experimental and control partners when comparing the first three categories (pre-contemplation through preparation) versus the last two (action and maintenance; Fisher's exact test: $p=0.016$)
[b] 1=pre-contemplation (Not thinking about eating more vegetables.); 2 = contemplation (Thinking about eating more vegetables. Planning to start within 6 months.); 3 = preparation (Definitely planning to eat more vegetables in the next month.); 4 = action (Trying to eat more vegetables now.); 5 = maintenance (Already eating 3 or more servings of vegetables a day.)
[c] 1 = disagree; 2 = neither agree nor disagree; 3 = agree
[d] 1=strongly dislike; 2 = dislike; 3= neutral or don't know; 4 = like; 5 = strongly like
[e] Average for carrots, sweet potatoes, butternut squash, acorn squash and pumpkin
[f] Average for spinach, kale, dark lettuce, collards, Swiss chard, mustard greens and turnip greens
[g] Average for cabbage, broccoli, cauliflower and Brussels sprouts

Table 3-4a: Baseline DHQ and VIA derived target vegetable intake for food preparers

	Exp/DHQ (n=25)	**Cont/DHQ (n=25)**		**Exp/VIA (n=25)**	**Cont/VIA (n=25)**	**Spearman Correlation Coefficients[a] comparing assessment by DHQ and VIA**
	MyPyramid cup equivalents/week (mean±std dev)					
Carrots	0.53±0.65	0.42±0.74		0.70±0.85	0.55±0.88	0.80**
Squash/Pumpkin[b]	0.05±0.14	0.08±0.15		0.06±0.18	0.02±0.06	0.37**
Sweet Potatoes	0.19±0.58	0.22±0.35		0.12±0.22	0.26±0.44	0.84**
Deep orange total	0.78±0.88	0.71±0.91		0.87±0.98	0.83±1.15	0.73**
Broccoli	0.78±1.27	0.95±0.92		0.59±0.44	0.81±0.70	0.60**
Cabbage/ Sauerkraut	0.16±0.38	0.20±0.32		0.20±0.42	0.19±0.26	0.73**
Cauliflower/ Brussels sprouts[c]	0.15±0.17	0.42±0.43		0.31±0.58	0.25±0.33	0.64**
Cole Slaw	0.17±0.23	0.29±0.60		0.26±0.26	0.39±0.85	0.78**
Cruciferous total	1.26±1.45	1.86±1.50		1.35±1.01	1.63±1.53	0.62**
Cooked Greens	0.17±0.44	0.18±0.52		0.25±0.65	0.11±0.25	0.74**
Dark Lettuce[d]				0.85±1.21	1.00±1.04	0.57**
Lettuce salads[d]	1.34±1.68	1.49±1.38				
Raw Greens	0.32±0.60	0.13±0.30		0.23±0.41	0.13±0.41	0.80**
Dark green leafy total	1.83±2.05	1.80±1.77		1.33±1.87	1.24±1.30	0.62**

[a] For square-root transformed vegetable intakes (n=50).
[b] Due to error, squash/pumpkin portion size options on the VIA were each ¼ cup less than those on the DHQ. However they were scored as if identical to the DHQ.
[c] Intake of cauliflower/Brussels sprouts was significantly different between experimental and control groups as measured by DHQ (t=-2.346; p=0.024).
[d] The DHQ assessed intake of 'lettuce salads' (i.e., any type of lettuce). The VIA specifically assessed intake of 'dark lettuce like red leaf and romaine' (not including iceberg), as lighter leaf lettuce was not among our vegetables of interest.
* Correlation is significant at the 0.05 level (two-tailed); ** Correlation is significant at the 0.01 level (two-tailed)

Table 3-4b. Baseline VIA derived target vegetable intake for partners

	Experimental (n=25)	**Control (n=25)**
	MyPyramid cup equivalents/week (mean+std dev)	
Carrots	0.48+0.53	0.44+0.66
Squash/Pumpkin	0.07+0.19	0.09+0.28
Sweet Potatoes	0.09+0.17	0.10+0.14
Deep orange total	0.64+0.55	0.63+0.82
Broccoli	1.06+1.31	0.62+0.69
Cabbage/Sauerkraut	0.27+0.41	0.18+0.27
Cauliflower/ Brussels sprouts	0.20+0.28	0.22+0.26
Cole Slaw	0.18+0.20	0.28+0.38
Cruciferous total	1.70+1.56	1.31+1.10
Cooked Greens	0.36+0.80	0.15+0.29
Dark Lettuce	0.74+1.41	0.60+1.05
Raw Greens	0.31+0.76	0.22+0.70
Dark green leafy total	1.41+2.52	0.97+1.24

* There were no significant differences between experimental versus control partners for baseline vegetable intake.

Table 3-4c. Baseline correlations between food preparers and partners for VIA derived target vegetable intake

	Spearman Correlation Coefficients[a,b] (n=50 couples)
Carrots	0.377**
Winter squash or pumpkin	0.334*
Sweet potatoes	0.336*
Deep orange total	0.268
Broccoli	0.330*
Coleslaw	0.372**
Sauerkraut or cabbage	0.596**
Cauliflower or Brussels sprouts	0.098
Cruciferous total	0.231
Dark lettuce	0.332*
Cooked greens	0.493**
Raw greens	0.282*
Dark green leafy total	0.338*

[a] For square-root transformed vegetable intakes expressed as MyPyramid cup equivalents/week (n=50).
* Correlation is significant at the 0.05 level (two-tailed); ** Correlation is significant at the 0.01 level (two-tailed)

Table 3-5. Readiness-to-eat more vegetables for partners[a,b]

	Experimental Partners			Control Partners		
	Pre-test (n=25)	**Post-test (n=23)**	**Follow-up (n=22)**	**Pre-test (n=25)**	**Post-test (n=21)**	**Follow-up (n=22)**
I am:						
Not thinking about eating more vegetables.	3 (12.0%)	0 (0.0%)	1 (4.5%)	2 (8.0%)	2 (9.5%)	3 (13.6%)
Thinking about eating more vegetables. Planning to start within 6 months.	1 (4.0%)	1 (4.3%)	0 (0.0%)	1 (4.0%)	1 (4.8%)	2 (9.1%)
Definitely planning to eat more vegetables in the next month.	9 (36.0%)	1 (4.3%)	4 (18.2%)	1 (4.0%)	0 (0.0%)	2 (9.1%)
Trying to eat more vegetables now.	9 (36.0%)	17 (73.9%)	12 (54.5%)	17 (68.0%)	15 71.4%)	10 (45.5%)
Already eating 3 or more servings of vegetables a day.	3 (12.0%)	4 (17.4%)	5 (22.7%)	4 (16.0%)	3 (14.3%)	5 (22.7%)
Mean Score $\pm$ Std Dev	3.32+1.15	4.04+0.64	3.91+0.92	3.80+1.04	3.76+1.09	3.55+1.34

[a] At baseline, there is a significant difference between experimental and control partners when comparing the first three categories (pre-contemplation through preparation) versus the last two (action and maintenance; Fisher's exact test: p=0.016)
[b] 1=pre-contemplation (Not thinking about eating more vegetables.); 2 = contemplation (Thinking about eating more vegetables. Planning to start within 6 months.); 3 = preparation (Definitely planning to eat more vegetables in the next month.); 4 = action (Trying to eat more vegetables now.); 5 = maintenance (Already eating 3 or more servings of vegetables a day.)

Table 3-6a. DHQ derived target vegetable intake for food preparers (means + SD)

	Measurement[b]	Experimental	Control	Effect	P^c
Personal Intake[a] (MyPyramid cup equivalents/week)					
Carrots	Baseline	0.53+0.65	0.42+0.74	Group	0.844
		--	--	Time	**0.003**
	Follow-up	0.67+0.80	0.89+1.13	Group x Time	0.099
Squash/pumpkin	Baseline	0.05+0.14	0.08+0.15	Group	0.591
		--	--	Time	0.012
	Follow-up	0.13+0.18	0.06+0.09	Group x Time[d]	**0.013**
Sweet potatoes	Baseline	0.19+0.58	0.22+0.35	Group	0.778
		--	--	Time	0.105
	Follow-up	0.23+0.34	0.23+0.41	Group x Time	0.479
Deep orange total	Baseline	0.78+0.88	0.71+0.91	Group	0.935
		--	--	Time	**0.005**
	Follow-up	1.03+0.97	1.18+1.32	Group x Time	0.467
Broccoli	Baseline	0.78+1.27	0.95+0.92	Group	0.184
		--	--	Time	0.440
	Follow-up	0.72+0.73	1.11+0.88	Group x Time	0.626
Cabbage/sauerkraut	Baseline	0.16+0.38	0.20+0.32	Group	0.289
		--	--	Time	0.719
	Follow-up	0.10+0.14	0.22+0.33	Group x Time	0.505
Cauliflower/Brussels sprouts	Baseline	0.15+0.17	0.42+0.43	Group	0.198
		--	--	Time	0.044
	Follow-up	0.42+0.60	0.39+0.36	Group x Time[d]	**0.049**
Cole slaw	Baseline	0.17+0.23	0.29+0.60	Group	0.824
		--	--	Time	0.233
	Follow-up	0.28+0.56	0.35+0.84	Group x Time	0.670
Cruciferous total	Baseline	1.26+1.45	1.86+1.50	Group	0.098
		--	--	Time	0.211
	Follow-up	1.51+1.34	2.06+1.74	Group x Time	0.781
Cooked greens	Baseline	0.17+0.44	0.18+0.52	Group	0.907
		--	--	Time	**0.045**
	Follow-up	0.28+0.44	0.32+0.67	Group x Time	0.749
Lettuce salads	Baseline	1.34+1.68	1.49+1.38	Group	0.674
		--	--	Time	0.592
	Follow-up	1.50+2.88	1.43+1.43	Group x Time	0.640
Raw greens	Baseline	0.32+0.60	0.13+0.30	Group	0.208
		--	--	Time	0.076
	Follow-up	0.42+0.63	0.36+0.81	Group x Time	0.774
Dark green leafy total	Baseline	1.83+2.05	1.80+1.77	Group	0.978
		--	--	Time	0.497
	Follow-up	2.20+3.30	2.12+2.24	Group x Time	0.985

Total target	Baseline	3.86+3.97	4.37+3.07	Group	0.395
		--	--	Time	0.071
	Follow-up	4.74+4.72	5.36+4.04	Group x Time	0.868
Total – C,B,L	Baseline	1.21+1.29	1.51+1.31	Group	0.526
		--	--	Time	**0.027**
	Follow-up	1.85+1.70	1.93+1.91	Group x Time	0.555
Total in recipes	Baseline	0.89+1.14	1.02+1.00	Group	0.968
		--	--	Time	**0.032**
	Follow-up	1.48+1.45	1.36+1.60	Group x Time	0.379

[a] Data were square root transformed for analysis.
[b] Baseline: n=25 experimentals and n=25 controls; Follow-up: n=22 experimentals and n=23 controls.
[c] P values were derived from a linear mixed model analysis with repeated measures.
[d] A significant group x time interaction indicates that the response over time differed significantly between the two groups.

Table 3-6b. VIA derived target vegetable intake for food preparers (means ± SD)

	Measurement[b]	Experimental	Control	Effect	*P* [c]
Personal Intake[a] (MyPyramid cup equivalents/week)					
Carrots	Baseline	0.70±0.85	0.55±0.88	Group	0.695
	Post-test	0.73±0.72	0.71±1.02	Time	0.113
	Follow-up	0.84±1.16	0.86±1.04	Group x Time	0.724
Squash/pumpkin	Baseline	0.06±0.18	0.02±0.06	Group	0.349
	Post-test	0.15±0.31	0.08±0.14	Time	**0.004**
	Follow-up	0.10±0.30	0.05±0.08	Group x Time	0.917
Sweet potatoes	Baseline	0.12±0.22	0.26±0.44	Group	0.347
	Post-test	0.24±0.40	0.26±0.31	Time	**0.003**
	Follow-up	0.26±0.54	0.18±0.25	Group x Time	0.516
Deep orange total	Baseline	0.87±0.98	0.83±1.15	Group	0.890
	Post-test	1.12±1.07	1.05±1.22	Time	**0.042**
	Follow-up	1.20±1.46	1.09±1.23	Group x Time	0.994
Broccoli	Baseline	0.59±0.44	0.81±0.70	Group	0.125
	Post-test	0.85±1.02	1.05±0.81	Time	0.073
	Follow-up	0.80±1.00	1.27±1.10	Group x Time	0.572
Cabbage/sauerkraut	Baseline	0.20±0.42	0.19±0.26	Group	0.279
	Post-test	0.13±0.23	0.23±0.28	Time	0.489
	Follow-up	0.12±0.19	0.22±0.36	Group x Time	0.700
Cauliflower/Brussels sprouts	Baseline	0.31±0.58	0.25±0.33	Group	0.292
	Post-test	0.62±0.94	0.43±0.56	Time	**0.017**
	Follow-up	0.43±0.61	0.26±0.36	Group x Time	0.723
Cole slaw	Baseline	0.26±0.26	0.39±0.85	Group	0.608
	Post-test	0.21±0.24	0.41±1.16	Time	0.258
	Follow-up	0.30±0.40	0.58±1.26	Group x Time	0.429
Cruciferous total	Baseline	1.35±1.01	1.63±1.53	Group	0.300
	Post-test	1.81±1.90	2.13±1.73	Time	0.112
	Follow-up	1.65±1.57	2.34±2.25	Group x Time	0.634
Cooked greens	Baseline	0.25±0.65	0.11±0.25	Group	0.612
	Post-test	0.37±0.56	0.35±0.57	Time	**0.028**
	Follow-up	0.38±0.64	0.38±0.92	Group x Time	0.781
Dark Lettuce	Baseline	0.85±1.21	1.00±1.04	Group	0.818
	Post-test	1.18±1.73	1.47±1.95	Time	0.145
	Follow-up	1.54±2.13	1.24±1.57	Group x Time	0.791
Raw greens	Baseline	0.23±0.41	0.13±0.41	Group	0.256
	Post-test	0.16±0.25	0.43±0.72	Time	0.020
	Follow-up	0.57±0.75	0.25±0.50	Group x Time[d]	**0.026**
Dark green leafy total	Baseline	1.33±1.87	1.24±1.30	Group	0.912
	Post-test	1.70±2.41	2.25±2.96	Time	**0.022**
	Follow-up	2.48±3.04	1.86±2.39	Group x Time	0.513

Total target	Baseline	3.56±2.44	3.70±2.83	Group	0.770
	Post-test	4.63±4.86	5.43±4.02	Time	**0.005**
	Follow-up	5.34±4.67	5.30±4.48	Group x Time	0.705
Total – C,B,L	Baseline	1.42±1.10	1.34±1.30	Group	0.953
	Post-test	1.87±2.19	2.20±1.68	Time	**0.006**
	Follow-up	2.16±2.04	1.93±2.05	Group x Time	0.334
Total in recipes	Baseline	0.96±0.94	0.77±0.85	Group	0.417
	Post-test	1.53±2.14	1.56±1.45	Time	**0.001**
	Follow-up	1.74±1.88	1.12±1.46	Group x Time	0.215

[a] Data were square root transformed for analysis.
[b] Baseline: n=25 experimentals and n=25 controls; Post-test: n=23 experimentals and n=22 controls; Follow-up: n=22 experimentals and n=23 controls.
[c] P values were derived from a linear mixed model analysis with repeated measures.
[d] A significant group x time interaction indicates that the response over time differed significantly between the two groups.

Table 3-6c. VIA derived target vegetable intake for partners (means ± SD)

	Measurement[b]	Experimental	Control	Effect	*P*[c]
Personal Intake[a] (MyPyramid cup equivalents/week)					
Carrots	Baseline	0.48±0.53	0.44±0.66	Group	0.069
	Post-test	1.03±1.72	0.53±0.61	Time	0.065
	Follow-up	1.10±1.78	0.46±0.67	Group x Time	0.083
Squash/pumpkin	Baseline	0.07±0.19	0.09±0.28	Group	0.868
	Post-test	0.11±0.18	0.16±0.32	Time	**0.006**
	Follow-up	0.12±0.53	0.02±0.07	Group x Time	0.631
Sweet potatoes	Baseline	0.09±0.17	0.10±0.14	Group	0.429
	Post-test	0.25±0.30	0.44±0.75	Time	**0.000**
	Follow-up	0.26±0.71	0.15±0.23	Group x Time	0.934
Deep orange total	Baseline	0.64±0.55	0.63±0.82	Group	0.183
	Post-test	1.39±1.72	1.12±1.18	Time	**0.000**
	Follow-up	1.49±2.02	0.63±0.86	Group x Time	0.156
Broccoli	Baseline	1.06±1.31	0.62±0.69	Group	0.484
	Post-test	1.28±1.09	1.33±1.23	Time	**0.012**
	Follow-up	1.44±2.18	0.98±0.95	Group x Time	0.256
Cabbage/sauerkraut	Baseline	0.27±0.41	0.18±0.27	Group	0.331
	Post-test	0.18±0.22	0.28±0.32	Time	0.176
	Follow-up	0.10±0.14	0.30±0.62	Group x Time	0.159
Cauliflower/Brussels sprouts	Baseline	0.20±0.28	0.22±0.26	Group	0.999
	Post-test	0.51±0.74	0.39±0.41	Time	**0.040**
	Follow-up	0.53±0.87	0.28±0.41	Group x Time	0.546
Cole slaw	Baseline	0.18±0.20	0.28±0.38	Group	0.148
	Post-test	0.24±0.38	0.25±0.35	Time	**0.014**
	Follow-up	0.23±0.24	0.46±0.43	Group x Time	0.246
Cruciferous total	Baseline	1.70±1.56	1.31±1.10	Group	0.856
	Post-test	2.20±1.75	2.25±1.47	Time	**0.012**
	Follow-up	2.30±2.92	2.01±1.50	Group x Time	0.319
Cooked greens	Baseline	0.36±0.80	0.15±0.29	Group	0.220
	Post-test	0.65±0.98	0.36±0.58	Time	**0.020**
	Follow-up	0.48±0.90	0.16±0.28	Group x Time	0.414
Dark Lettuce	Baseline	0.74±1.41	0.60±1.05	Group	0.468
	Post-test	0.80±1.27	1.36±1.69	Time	**0.011**
	Follow-up	0.81±1.03	1.71±3.10	Group x Time	0.472
Raw greens	Baseline	0.31±0.76	0.22±0.70	Group	0.762
	Post-test	0.15±0.28	0.54±1.28	Time	0.391
	Follow-up	0.35±0.57	0.37±0.77	Group x Time	0.240
Dark green leafy	Baseline	1.41±2.52	0.97±1.24	Group	0.698

total	Post-test	1.61±2.04	2.25±2.52	Time	**0.006**
	Follow-up	1.64±2.18	2.25±3.31	Group x Time	0.598
Total target	Baseline	3.75±3.63	2.92±2.18	Group	0.764
	Post-test	5.20±4.52	5.63±4.13	Time	**0.000**
	Follow-up	5.42±6.09	4.89±4.06	Group x Time	0.437
Total – C,B,L	Baseline	1.47±1.46	1.25±0.96	Group	0.974
	Post-test	2.09±1.98	2.41±2.20	Time	**0.005**
	Follow-up	2.07±2.22	1.73±1.47	Group x Time	0.622
Total in recipes	Baseline	1.03±1.33	0.78±0.86	Group	0.526
	Post-test	1.67±1.75	1.88±2.26	Time	**0.003**
	Follow-up	1.75±2.18	0.98±1.19	Group x Time	0.422

[a] Data were square root transformed for analysis.
[b] Baseline: n=25 experimentals and n=25 controls; Post-test: n=23 experimentals and n=21 controls; Follow-up: n=22 experimentals and n=22 controls.
[c] P values were derived from a linear mixed model analysis with repeated measures.

Table 3-7a. Characteristics of family meals for food preparers (means ± SD)

	Measurement[a]	Experimental	Control	Effect	*P* [b]
Number of family meals/week	Baseline	5.6±1.6	5.6±1.4	Group	0.113
	Post-test	5.4±1.6	4.8±1.9	Time	0.049
	Follow-up	5.7±1.4	4.5±1.8	Group x Time[c]	**0.046**
Frequency served at meals (x/week)					
Carrots	Baseline	0.89±1.29	1.23±1.34	Group	0.587
	Post-test	1.04±1.00	0.93±0.92	Time	0.785
	Follow-up	1.02±1.19	1.20±1.24	Group x Time	0.442
Squash/pumpkin	Baseline	0.06±0.17	0.02±0.06	Group	0.404
	Post-test	0.13±0.26	0.10±0.18	Time	0.106
	Follow-up	0.09±0.43	0.06±0.10	Group x Time	0.990
Sweet potatoes	Baseline	0.16±0.30	0.24±0.44	Group	0.723
	Post-test	0.29±0.34	0.31±0.29	Time	0.111
	Follow-up	0.27±0.46	0.23±0.26	Group x Time	0.640
Deep orange total	Baseline	1.11±1.25	1.48±1.63	Group	0.667
	Post-test	1.46±1.34	1.34±1.07	Time	0.702
	Follow-up	1.38±1.40	1.50±1.40	Group x Time	0.426
Broccoli	Baseline	0.95±0.95	1.27±1.11	Group	0.328
	Post-test	1.25±1.16	1.35±1.04	Time	0.217
	Follow-up	1.13±1.18	1.57±1.18	Group x Time	0.431
Cabbage/sauerkraut	Baseline	0.17±0.25	0.24±0.42	Group	0.183
	Post-test	0.24±0.42	0.39±0.57	Time	0.308
	Follow-up	0.19±0.44	0.38±0.57	Group x Time	0.781
Cauliflower/Brussels sprouts	Baseline	0.34±0.45	0.42±0.48	Group	0.626
	Post-test	0.79±1.43	0.55±0.55	Time	0.219
	Follow-up	0.40±0.44	0.37±0.44	Group x Time	0.552
Cole slaw	Baseline	0.20±0.21	0.34±0.67	Group	0.263
	Post-test	0.18±0.31	0.23±0.43	Time	0.196
	Follow-up	0.22±0.37	0.42±0.56	Group x Time	0.380
Cruciferous total	Baseline	1.65±1.15	2.27±1.95	Group	0.287
	Post-test	2.47±2.35	2.52±1.90	Time	0.149
	Follow-up	1.93±1.71	2.73±1.91	Group x Time	0.300
Cooked greens	Baseline	0.37±0.76	0.16±0.41	Group	0.630
	Post-test	0.48±0.79	0.40±0.72	Time	**0.046**
	Follow-up	0.49±0.87	0.46±0.94	Group x Time	0.365
Dark Lettuce	Baseline	1.03±1.33	1.44±1.21	Group	0.705
	Post-test	1.62±1.95	1.60±1.96	Time	0.134
	Follow-up	1.65±2.00	1.77±1.67	Group x Time	0.275

Raw greens	Baseline	0.43+0.82	0.24+0.70	Group	0.532
	Post-test	0.26+0.33	0.57+1.07	Time	**0.036**
	Follow-up	0.89+1.19	0.49+0.83	Group x Time	0.076
Dark green leafy total	Baseline	1.83+2.15	1.84+1.71	Group	0.881
	Post-test	2.35+2.73	2.57+3.38	Time	**0.013**
	Follow-up	3.03+3.32	2.72+2.79	Group x Time	0.941
Total target	Baseline	4.58+3.31	5.59+3.77	Group	0.694
	Post-test	6.27+5.89	6.44+4.65	Time	**0.021**
	Follow-up	6.35+5.50	6.95+5.33	Group x Time	0.470
Total – C,B,L	Baseline	1.72+1.45	1.65+1.52	Group	0.866
	Post-test	2.37+2.74	2.56+2.02	Time	**0.003**
	Follow-up	2.55+2.54	2.41+2.08	Group x Time	0.983
Total in recipes	Baseline	1.35+1.32	1.07+1.16	Group	0.459
	Post-test	1.95+2.59	1.93+1.88	Time	**0.004**
	Follow-up	2.14+2.29	1.61+1.90	Group x Time	0.823

[a] Baseline: n=25 experimentals and n=25 controls; Post-test: n=23 experimentals and n=22 controls; Follow-up: n=22 experimentals and n=23 controls.
[b] P values were derived from a linear mixed model analysis with repeated measures.
[c] A significant group x time interaction indicates that the response over time differed significantly between the two groups.

Table 3-7b. Characteristics of family meals for partners (means ± SD)

	Measurement[a]	Experimental	Control	Effect	*P* [b]
Number of family meals/week	Baseline	5.3±1.7	5.7±1.4	Group	0.685
	Post-test	5.2±1.4	4.7±1.8	Time	0.005
	Follow-up	5.4±1.6	5.1±1.9	Group x Time[c]	**0.023**
Frequency served at meals (x/week)					
Carrots	Baseline	0.83±0.98	0.64±0.58	Group	0.438
	Post-test	1.31±1.34	1.16±1.04	Time	**0.007**
	Follow-up	1.23±1.53	1.02±0.79	Group x Time	0.988
Squash/pumpkin	Baseline	0.07±0.17	0.07±0.13	Group	0.858
	Post-test	0.11±0.20	0.19±0.32	Time	**0.009**
	Follow-up	0.06±0.22	0.01±0.05	Group x Time	0.234
Sweet potatoes	Baseline	0.10±0.19	0.16±0.26	Group	0.614
	Post-test	0.36±0.32	0.46±0.57	Time	**0.000**
	Follow-up	0.28±0.71	0.22±0.27	Group x Time	0.706
Deep orange total	Baseline	1.00±0.97	0.87±0.75	Group	0.618
	Post-test	1.77±1.44	1.81±1.52	Time	**0.000**
	Follow-up	1.56±1.60	1.26±0.92	Group x Time	0.729
Broccoli	Baseline	1.11±0.95	1.00±0.96	Group	0.569
	Post-test	1.52±1.16	1.37±1.13	Time	**0.027**
	Follow-up	1.57±1.68	1.46±1.12	Group x Time	0.953
Cabbage/sauerkraut	Baseline	0.33±0.56	0.20±0.41	Group	0.908
	Post-test	0.28±0.43	0.29±0.28	Time	0.882
	Follow-up	0.27±0.47	0.34±0.47	Group x Time	0.422
Cauliflower/Brussels sprouts	Baseline	0.26±0.42	0.35±0.44	Group	0.868
	Post-test	0.88±1.27	0.64±0.65	Time	**0.005**
	Follow-up	0.72±1.48	0.73±0.94	Group x Time	0.525
Cole slaw	Baseline	0.12±0.19	0.24±0.41	Group	0.105
	Post-test	0.16±0.21	0.26±0.34	Time	0.227
	Follow-up	0.19±0.32	0.35±0.48	Group x Time	0.676
Cruciferous total	Baseline	1.81±1.21	1.79±1.51	Group	0.881
	Post-test	2.84±2.19	2.56±1.68	Time	**0.003**
	Follow-up	2.75±3.54	2.88±2.19	Group x Time	0.731
Cooked greens	Baseline	0.44±0.83	0.23±0.45	Group	0.073
	Post-test	0.79±0.94	0.38±0.59	Time	0.121
	Follow-up	0.70±0.94	0.38±0.64	Group x Time	0.790
Dark Lettuce	Baseline	0.87±1.23	1.04±1.18	Group	0.894
	Post-test	1.23±1.34	1.40±1.50	Time	**0.004**

	Follow-up	1.76±1.58	1.53±1.80	Group x Time	0.556
Raw greens	Baseline	0.31±0.76	0.15±0.30	Group	0.846
	Post-test	0.25±0.30	0.77±1.34	Time	0.030
	Follow-up	0.77±1.20	0.48±0.86	Group x Time[c]	**0.054**
Dark green leafy total	Baseline	1.62±2.46	1.41±1.54	Group	0.696
	Post-test	2.27±1.78	2.56±2.69	Time	**0.002**
	Follow-up	3.23±3.26	2.38±2.58	Group x Time	0.334
Total target	Baseline	4.43±3.40	4.07±2.78	Group	0.702
	Post-test	6.88±4.56	6.94±4.84	Time	**0.001**
	Follow-up	7.55±7.16	6.52±4.86	Group x Time	0.774
Total – C,B,L	Baseline	1.63±1.75	1.40±1.30	Group	0.824
	Post-test	2.82±2.06	3.00±2.80	Time	**0.000**
	Follow-up	2.98±3.39	2.51±2.38	Group x Time	0.744
Total in recipes	Baseline	1.18±1.62	0.95±1.06	Group	0.623
	Post-test	2.38±1.93	2.45±2.72	Time	**0.000**
	Follow-up	2.52±2.86	1.82±1.97	Group x Time	0.639

[a] Baseline: n=25 experimentals and n=25 controls; Post-test: n=23 experimentals and n=21 controls; Follow-up: n=22 experimentals and n=22 controls.
[b] P values were derived from a linear mixed model analysis with repeated measures.
[c] A significant group x time interaction indicates that the response over time differed significantly between the two groups.

Table 3-8. DHQ daily nutrient values & step equivalents for food preparers (means ± SD)

Nutrient	Measurement[b]	Experimental	Control	Effect	*P*[c]
Energy - kcal	Baseline	1835±720	2055±762	Group	0.218
		--	--	Time	0.060
	Follow-up	1727±696	1951±716	Group x Time	0.797
Fiber – g[a]	Baseline	18.3±7.3	19.3±8.3	Group	0.499
		--	--	Time	0.105
	Follow-up	18.3±8.9	19.9±10.1	Group x Time	0.959
CHO - % kcal	Baseline	48.7±7.4	45.9±8.6	Group	0.246
		--	--	Time	0.233
	Follow-up	48.8±6.0	47.5±7.9	Group x Time	0.529
Protein - % kcal	Baseline	16.8±2.5	16.4±2.8	Group	0.973
		--	--	Time	0.546
	Follow-up	16.3±2.2	16.4±2.5	Group x Time	0.238
Total fat - % kcal	Baseline	36.4±6.5	39.0±6.9	Group	0.221
		--	--	Time	0.395
	Follow-up	36.6±5.9	38.0±6.8	Group x Time	0.490
Vitamin A – IU[a]	Baseline	9526±6574	10117±6549	Group	0.850
		--	--	Time	**0.007**
	Follow-up	10538±6982	13378±9951	Group x Time	0.565
Vitamin A – mcg RE[a]	Baseline	1293±700	1391±737	Group	0.912
		--	--	Time	**0.018**
	Follow-up	1355±712	1691±1106	Group x Time	0.542
Vitamin C - mg[a]	Baseline	136±84	136±69	Group	0.979
		--	--	Time	0.143
	Follow-up	129±61	159±80	Group x Time	0.277
Carotene – mcg RE[a]	Baseline	784±647	823±637	Group	0.825
		--	--	Time	**0.005**
	Follow-up	905±699	1162±947	Group x Time	0.583
Lutein - mcg[a]	Baseline	2639±1998	2749±2063	Group	0.997
		--	--	Time	0.137
	Follow-up	2754±1916	3178±2326	Group x Time	0.618
Step equivalents	Baseline	5798±5423	5715±3761	Group	0.218
	Post-test	7199±5707	3219±1855	Time	0.430
	Follow-up	9427±5952	5630±7301	Group x Time	0.254

[a] Data were energy-adjusted for analysis.
[b] For Nutrient Intake: Baseline: n=25 experimentals and n=25 controls; Follow-up: n=22 experimentals and n=23 controls.
For steps: Baseline: n=20 experimentals and n=8 controls; Post-test: n=20 experimentals and n=6 controls; Follow-up: n=14 experimentals and n=3 controls.
[c] P values were derived from a linear mixed model analysis with repeated measures.

Table 3-9. Change in VIA derived target vegetable intake based on meal diary score (number of recipes for which total family score was 5 or 6;[a-c] means ± SD)

	Measurement[e]	Meal diary score 0 to 6 (low)	7 to 15 (high)	Effect	*P* [f]
Personal Intake[d] (MyPyramid cup equivalents/week)					
Food Preparers – Experimental					
Total target	Baseline	3.28±2.36	3.74±2.56	Group	0.053
	Post-test	2.30±2.08	5.88±5.50	Time	0.556
	Follow-up	2.35±2.44	6.73±4.87	Group x Time[g]	**0.009**
Total – C,B,L	Baseline	1.43±0.77	1.40±1.30	Group	0.105
	Post-test	0.91±0.88	2.38±2.52	Time	0.816
	Follow-up	0.96±1.23	2.72±2.12	Group x Time[g]	**0.007**
Total in recipes	Baseline	0.99±0.79	0.94±1.05	Group	0.096
	Post-test	0.69±0.74	1.98±2.52	Time	0.516
	Follow-up	0.65±0.76	2.25±2.05	Group x Time[g]	**0.008**
Partners - Experimental					
Total target	Baseline	3.39±2.80	3.99±4.17	Group	0.178
	Post-test	4.09±2.17	5.79±5.35	Time	0.215
	Follow-up	3.16±3.02	6.48±6.92	Group x Time	**0.006**
Total – C,B,L	Baseline	1.50±1.30	1.46±1.60	Group	0.351
	Post-test	1.92±1.19	2.17±2.33	Time	0.288
	Follow-up	1.25±1.43	2.45±2.45	Group x Time	0.061
Total in recipes	Baseline	1.03±1.29	1.03±1.40	Group	0.238
	Post-test	1.44±1.16	1.79±2.03	Time	0.113
	Follow-up	0.91±1.50	2.14±2.38	Group x Time	**0.019**
Food Preparers – Control					
Total target	Baseline	3.47±2.45	5.38±5.29	Group	0.389
	Post-test	5.07±3.77	7.71±5.73	Time	**0.044**
	Follow-up	5.16±4.62	6.19±4.08	Group x Time	0.538
Total – C,B,L	Baseline	1.39±1.33	1.00±1.23	Group	0.819
	Post-test	2.08±1.64	2.97±2.09	Time	**0.003**
	Follow-up	1.97±2.20	1.60±0.30	Group x Time	0.163
Total in recipes	Baseline	0.77±0.83	0.80±1.16	Group	0.574
	Post-test	1.43±1.31	2.38±2.39	Time	**0.008**
	Follow-up	1.11±1.54	1.21±0.90	Group x Time	0.440
Partners - Control					
Total target	Baseline	2.64±1.78	4.92±4.12	Group	0.382
	Post-test	5.38±3.61	7.10±7.47	Time	0.061
	Follow-up	4.63±3.93	6.50±5.43	Group x Time	0.813
Total – C,B,L	Baseline	1.22±0.97	1.46±1.04	Group	0.871
	Post-test	2.28±2.02	3.22±3.57	Time	**0.027**
	Follow-up	1.83±1.55	1.09±0.71	Group x Time	0.296

Total in recipes	Baseline	0.71±0.83	1.34±1.06	Group	0.403
	Post-test	1.71±2.07	2.88±3.55	Time	0.081
	Follow-up	1.00±1.25	0.80±0.90	Group x Time	0.472

[a] For each recipe, scores of 0=refused; 1=tasted; 2=ate were assigned to each of three family members, the food preparer, partner and a child. These scores were summed to provide a total family score ranging from 0 to 6 for each recipe. A total family score of 5 for a recipe meant two parents and a child all tasted it and two ate it; a score of 6 meant they all tasted it and ate it. Example, if a food preparer and partner ate and a child tasted a recipe, the total family score for that recipe is 2+2+1=5.
[b] The score of '0' for 'Number of recipes' includes experimental and control non-responders.
[c] Considers 15 recipes (all intervention recipes except the three fruit lesson recipes).
[d] Data were square root transformed for analysis.
[e] Food Preparers & Partners - Experimental: Baseline: n=10 low-score (LS) and n=15 high-score (HS); Post-test: n=8 LS and n=15 HS; Follow-up: n=7 LS and n=15 HS.
Food Preparers - Control: Baseline: n=22 LS and n=3 HS; Post-test: n=19 LS and n=3 HS; Follow-up: n=20 LS and n=3 HS.
Partners - Control: Baseline: n=22 LS and n=3 HS; Post-test: n=18 LS and n=3 HS; Follow-up: n=19 LS and n=3 HS.
[f] P values were derived from a linear mixed model analysis with repeated measures.
[g] A significant group x time interaction indicates that the response over time differed significantly between the two groups.

Table 3-10. Change in DHQ derived target vegetable intake based on meal diary score (number of recipes for which total family score was 5 or 6;[a-c] means ± SD)

	Measurement[e]	Meal diary score 0 to 6 (low)	7 to 15 (high)	Effect	*P* [f]
Personal Intake[d] (MyPyramid cup equivalents/week)					
Food Preparers – Experimental					
Total target	Baseline	2.38±1.72	4.85±4.75	Group	0.038
		--	--	Time	0.506
	Follow-up	1.93±1.39	6.06±5.17	Group x Time	0.184
Total – C,B,L	Baseline	0.90±0.70	1.42±1.56	Group	0.065
		--	--	Time	0.235
	Follow-up	0.67±0.52	2.41±1.78	Group x Time[g]	**0.052**
Total in recipes	Baseline	0.62±0.67	1.07±1.36	Group	0.034
		--	--	Time	0.152
	Follow-up	0.45±0.24	1.97±1.53	Group x Time[g]	0.074
Food Preparers – Control					
Total target	Baseline	4.23±2.74	5.40±5.68	Group	0.571
		--	--	Time	0.271
	Follow-up	5.20±4.13	6.45±3.98	Group x Time	0.698
Total – C,B,L	Baseline	1.53±1.32	1.39±1.48	Group	0.939
		--	--	Time	0.300
	Follow-up	1.97±2.04	1.67±0.42	Group x Time	0.728
Total in recipes	Baseline	1.00±0.95	1.23±1.53	Group	0.880
		--	--	Time	0.547
	Follow-up	1.38±1.69	1.28±0.99	Group x Time	0.989

[a] For each recipe, scores of 0=refused; 1=tasted; 2=ate were assigned to each of three family members, the food preparer, partner and a child. These scores were summed to provide a total family score ranging from 0 to 6 for each recipe. A total family score of 5 for a recipe meant two parents and a child all tasted it and two ate it; a score of 6 meant they all tasted it and ate it. Example, if a food preparer and partner ate and a child tasted a recipe, the total family score for that recipe is 2+2+1=5.
[b] The score of '0' for 'Number of recipes' includes experimental and control non-responders.
[c] Considers 15 recipes (all intervention recipes except the three fruit lesson recipes).
[d] Data were square root transformed for analysis.
[e] Experimental: Baseline: n=10 low-score (LS) and n=15 high-score (HS); Follow-up: n=7 LS and n=15 HS.
Control: Baseline: n=22 LS and n=3 HS; Follow-up: n=20 LS and n=3 HS.
[f] P values were derived from a linear mixed model analysis with repeated measures.
[g] A significant group x time interaction indicates that the response over time differed significantly between the two groups.

Table 3-11. Change in frequency of target vegetables served at meals based on meal diary score (number of recipes for which total family score was 5 or 6;[a-c] means ± SD)

	Measurement[d]	Meal diary score 0 to 6 (low)	7 to 15 (high)	Effect	*P* [e]
Frequency served at meals (x/week)					
Food Preparers – Experimental					
Total target	Baseline	3.69±3.00	5.18±3.47	Group	0.066
	Post-test	2.60±2.37	8.23±6.31	Time	0.084
	Follow-up	2.58±2.27	8.11±5.72	Group x Time	0.081
Total – C,B,L	Baseline	1.56±1.19	1.82±1.64	Group	0.110
	Post-test	0.93±0.46	3.13±3.15	Time	0.167
	Follow-up	0.74±0.60	3.39±2.67	Group x Time	**0.018**
Total in recipes	Baseline	1.22±1.12	1.44±1.48	Group	0.144
	Post-test	0.76±0.33	2.58±3.04	Time	0.168
	Follow-up	0.56±0.38	2.88±2.44	Group x Time[f]	**0.036**
Partners - Experimental					
Total target	Baseline	4.14±3.39	4.62±3.51	Group	0.240
	Post-test	5.40±1.72	7.68±5.41	Time	**0.016**
	Follow-up	5.52±4.33	8.49±8.12	Group x Time	0.222
Total – C,B,L	Baseline	1.87±2.27	1.46±1.37	Group	0.282
	Post-test	2.30±1.06	3.10±2.42	Time	0.082
	Follow-up	1.90±1.90	3.49±3.85	Group x Time	0.069
Total in recipes	Baseline	1.48±2.24	0.98±1.08	Group	0.406
	Post-test	2.03±1.03	2.57±2.29	Time	0.086
	Follow-up	1.58±1.66	2.96±3.23	Group x Time	0.094
Food Preparers – Control					
Total target	Baseline	5.39±3.92	7.05±2.36	Group	0.232
	Post-test	5.95±4.48	9.56±5.46	Time	0.270
	Follow-up	6.50±5.53	9.98±2.51	Group x Time	0.698
Total – C,B,L	Baseline	1.69±1.56	1.39±1.37	Group	0.316
	Post-test	2.26±1.96	4.40±1.44	Time	**0.023**
	Follow-up	2.30±2.19	3.16±1.10	Group x Time	0.146
Total in recipes	Baseline	1.06±1.16	1.14±1.43	Group	0.264
	Post-test	1.70±1.87	3.42±1.43	Time	**0.044**
	Follow-up	1.49±1.95	2.41±1.66	Group x Time	0.322
Partners - Control					
Total target	Baseline	3.84±2.74	5.83±3.01	Group	0.207
	Post-test	6.21±4.58	11.29±4.74	Time	**0.011**
	Follow-up	6.42±5.01	7.14±4.68	Group x Time	0.145
Total – C,B,L	Baseline	1.39±1.33	1.45±1.34	Group	0.483
	Post-test	2.60±2.60	5.40±3.25	Time	**0.008**
	Follow-up	2.61±2.53	1.92±1.13	Group x Time[f]	0.099
Total in recipes	Baseline	0.90±1.03	1.30±1.45	Group	0.316
	Post-test	2.06±2.54	4.84±3.02	Time	**0.008**

Follow-up	1.86±2.09	1.59±1.23	Group x Time	0.134

[a] For each recipe, scores of 0=refused; 1=tasted; 2=ate were assigned to each of three family members, the food preparer, partner and a child. These scores were summed to provide a total family score ranging from 0 to 6 for each recipe. A total family score of 5 for a recipe meant two parents and a child all tasted it and two ate it; a score of 6 meant they all tasted it and ate it. Example, if a food preparer and partner ate and a child tasted a recipe, the total family score for that recipe is 2+2+1=5.
[b] The score of '0' for 'Number of recipes' includes experimental and control non-responders.
[c] Considers 15 recipes (all intervention recipes except the three fruit lesson recipes).
[d] Food Preparers & Partners - Experimental: Baseline: n=10 low-score (LS) and n=15 high-score (HS); Post-test: n=8 LS and n=15 HS; Follow-up: n=7 LS and n=15 HS.
Food Preparers - Control: Baseline: n=22 LS and n=3 HS; Post-test: n=19 LS and n=3 HS; Follow-up: n=20 LS and n=3 HS.
Partners - Control: Baseline: n=22 LS and n=3 HS; Post-test: n=18 LS and n=3 HS; Follow-up: n=19 LS and n=3 HS.
[e] P values were derived from a linear mixed model analysis with repeated measures.
[f] A significant group x time interaction indicates that the response over time differed significantly between the two groups.

Table 3-12. Demographic characteristics by meal diary score (number of recipes for which total family score was 5 or 6[a-c]) for experimental participants

	Food Preparers (n=25)			**Partners (n=25)**		
	Low MD score (n=10)	**High MD score (n=15)**	**p-value**	**Low MD score (n=10)**	**High MD score (n=15)**	**p-value**
Sex						
Female	10 (100%)	13 (87%)	0.500	0 (0%)	2 (13%)	0.500
Age, y (*mean* ± *SD*)	41.2±6.9	45.1±6.4	0.163	43.9±6.7	46.2±7.5	0.441
Years lived with partner (*mean* ± *SD*)	14.6±6.5	20.1±6.9	0.056	14.6±6.5	20.1±6.9	0.056
Hispanic or Latino	0 (0%)	0 (0%)	-	1 (10%)	2 (13%)	1.000
Race[d]			-			0.417
White	10 (100%)	15 (100%)		9 (90%)	14 (93%)	
Black	0 (0%)	0 (0%)		0 (0%)	0 (0%)	
American Indian or Alaska native	0 (0%)	0 (0%)		1 (10%)	0 (0%)	
Total	10	15		10	14	
Marital status			0.052			0.052
Married	7 (70%)	15 (100%)		7 (70%)	15 (100%)	
Living with partner	3 (30%)	0 (0%)		3 (30%)	0 (0%)	
Others living in household						
Partner or spouse	10 (100%)	15 (100%)		10 (100%)	15 (100%)	
Number of children (*mean* ± *SD*)	2.5±1.2	2.3±1.2	0.732	2.5±1.2	2.3±1.2	0.732
Other	1 (10%)	1 (7%)	1.000	1 (10%)	1 (7%)	1.000
Total in household (*mean* ± *SD*)	4.6±1.4	4.4±1.4	0.726	4.6±1.4	4.4±1.4	0.726
Education level[d]			1.000			1.000
High school diploma/GED or less	1 (10%)	3 (20%)		2 (20%)	3 (20%)	
Trade or business school	3 (30%)	2 (13%)		2 (20%)	3 (20%)	
Some college	3 (30%)	5 (33%)		3 (30%)	3 (20%)	
Bachelor's degree or higher	3 (30%)	5 (33%)		1 (10%)	3 (20%)	
Employment status[d]			0.659			1.000
Employed	8 (80%)	10 (67%)		9 (90%)	14 (93%)	
Unemployed	1 (10%)	3 (20%)		0 (0%)	0 (0%)	
Retired	1 (10%)	1 (7%)		1 (10%)	1 (7%)	
Other	0 (0%)	1 (7%)		0 (0%)	0 (0%)	

Annual household income[d]			0.117			0.117
$10,001 to $20,000	2 (20%)	1 (7%)		2 (20%)	1 (7%)	
$20,001 to $30,000	2 (20%)	1 (7%)		2 (20%)	1 (7%)	
$30,001 to $40,000	4 (40%)	4 (27%)		4 (40%)	4 (27%)	
$40,001 to $50,000	2 (20%)	9 (60%)		2 (20%)	9 (60%)	
Body Mass Index – self-report (*mean $\pm$ SD*)	33.6$\pm$8.9	33.8$\pm$9.5	0.946			

[a] For each recipe, scores of 0=refused; 1=tasted; 2=ate were assigned to each of three family members, the food preparer, partner and a child. These scores were summed to provide a total family score ranging from 0 to 6 for each recipe. A total family score of 5 for a recipe meant two parents and a child all tasted it and two ate it; a score of 6 meant they all tasted it and ate it. Example, if a food preparer and partner ate and a child tasted a recipe, the total family score for that recipe is 2+2+1=5.
[b] The score of '0' for 'Number of recipes' includes experimental and control non-responders.
[c] Considers 15 recipes (all intervention recipes except the three fruit lesson recipes).
[d] For analysis, some response options were combined to minimize the number of cells with expected frequencies of less than five (i.e., race=white/non-white; education level=trade or business school or less/at least some college; employment status=employed/not employed; income=$10,001-30,000/$30,001-40,000/$40,001-50,000).

Table 3-13. Baseline characteristics by meal diary score (number of recipes for which total family score was 5 or 6[a-c]) for experimental participants

	Food Preparers (n=25)			**Partners (n=25)**		
	Low MD score (n=10)	**High MD score (n=15)**	**p-value**	**Low MD score (n=10)**	**High MD score (n=15)**	**p-value**
***Readiness-to-eat more vegetables*[d]**						
Pre-contemplation	0 (0%)	0 (0%)		0 (0%)	3 (20%)	
Contemplation	0 (0%)	0 (0%)		1 (10%)	0 (0%)	
Preparation	1 (10%)	1 (7%)		4 (40%)	5 (33%)	
Action	8 (80%)	9 (60%)		5 (50%)	4 (27%)	
Maintenance	1 (10%)	5 (33%)		0 (0%)	3 (20%)	
Mean ± Std Dev	4.00±0.47	4.27±0.59	0.246	3.40±0.70	3.27±1.39	0.782
***Self-efficacy*[e]**						
I feel that I can:	*Means ± Std Dev*			*Means ± Std Dev*		
Buy more vegetables the next time I shop	2.70±0.48	3.00±0.00	0.081	--	--	
Plan meals with more vegetables during the next week	2.60±0.70	2.87±0.35	0.286	--	--	
Add extra vegetables to casseroles and stews	2.50±0.85	2.73±0.46	0.442	--	--	
Eat two or more servings of vegetables at dinner	2.80±0.42	2.80±0.41	1.000	--	--	
***Vegetable-liking*[f]**	*Means ± Std Dev*			*Means ± Std Dev*		
Deep orange[g]	3.6±0.9	4.1±0.5	0.132	3.7±0.8	3.8±0.5	0.784
Cruciferous[h]	4.3±0.5	4.1±0.7	0.596	3.8±0.9	4.0±0.6	0.405
Dark green leafy[i]	3.3±0.7	3.4±0.7	0.792	3.3±0.7	3.2±0.7	0.843
Number of family meals/week	*Means ± Std Dev*			*Means ± Std Dev*		
	5.9±1.2	5.4±1.8	0.424	5.3±1.4	5.3±2.0	0.982

[a] For each recipe, scores of 0=refused; 1=tasted; 2=ate were assigned to each of three family members, the food preparer, partner and a child. These scores were summed to provide a total family score ranging from 0 to 6 for each recipe. A total family score of 5 for a recipe meant two parents and a child all tasted it and two ate it; a score of 6 meant they all tasted it and ate it. Example, if a food preparer and partner ate and a child tasted a recipe, the total family score for that recipe is 2+2+1=5.
[b] The score of '0' for 'Number of recipes' includes experimental and control non-responders.
[c] Considers 15 recipes (all intervention recipes except the three fruit lesson recipes).
[d] 1=pre-contemplation (Not thinking about eating more vegetables.); 2 = contemplation (Thinking about eating more vegetables. Planning to start within 6 months.); 3 = preparation (Definitely planning to eat more vegetables in the next month.); 4 = action (Trying to eat more vegetables now.); 5 = maintenance (Already eating 3 or more servings of vegetables a day.)
[e] 1 = disagree; 2 = neither agree nor disagree; 3 = agree
[f] 1=strongly dislike; 2 = dislike; 3= neutral or don't know; 4 = like; 5 = strongly like
[g] Average for carrots, sweet potatoes, butternut squash, acorn squash and pumpkin
[h] Average for spinach, kale, dark lettuce, collards, Swiss chard, mustard greens and turnip greens
[i] Average for cabbage, broccoli, cauliflower and Brussels sprouts

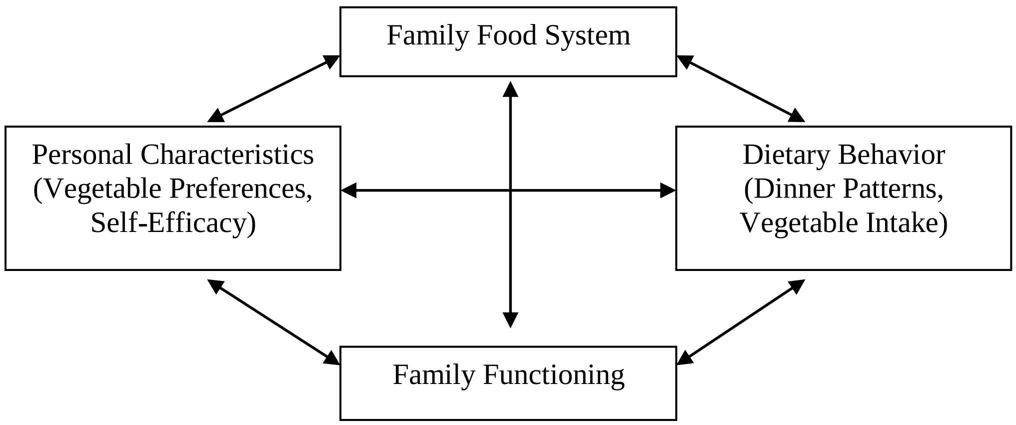
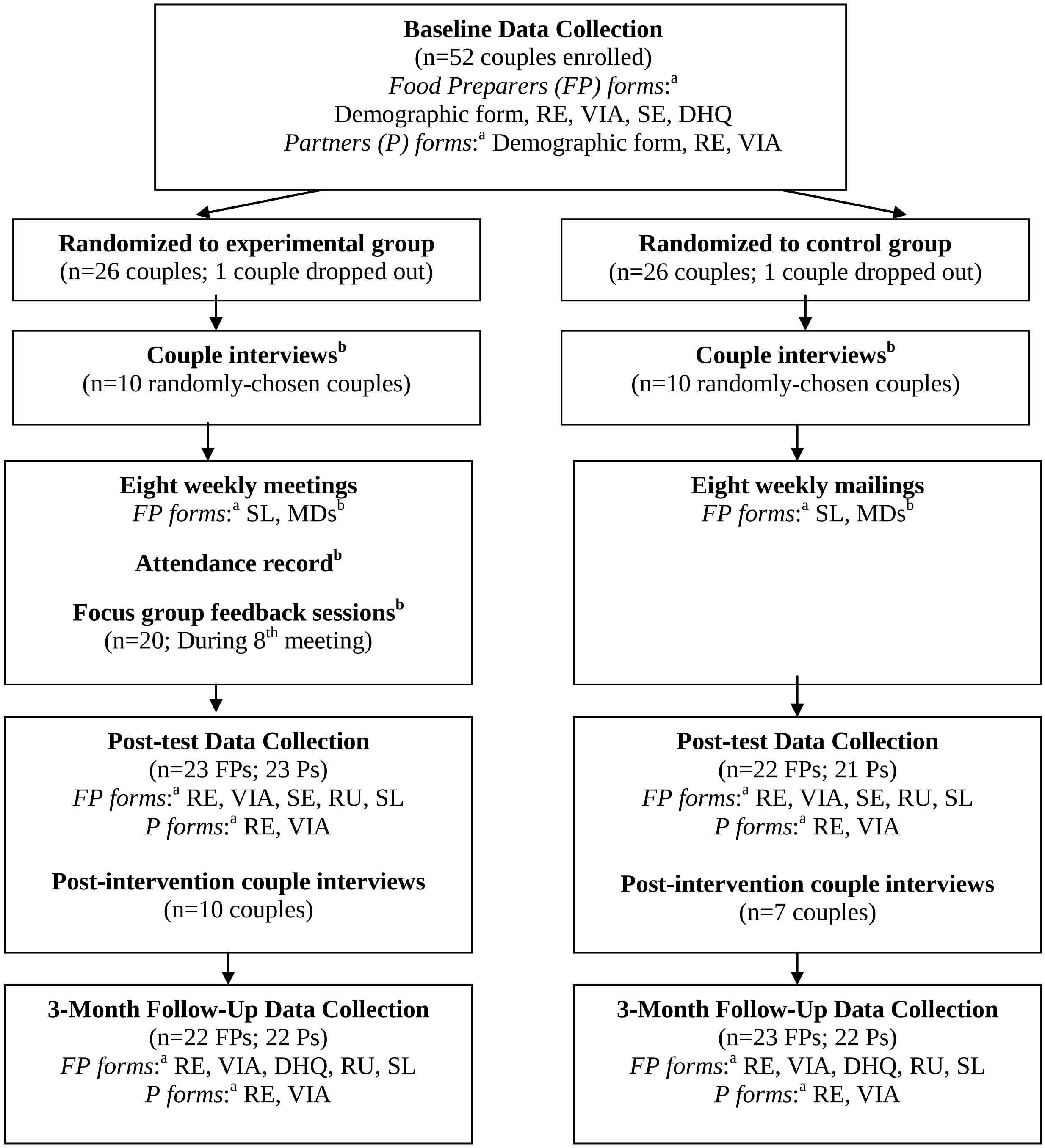


Figure 3-1. Baranowski's reciprocal determinism model as used in this study



[a] Form acronyms: RE=readiness-to-eat more vegetables; VIA=vegetable intake assessment; SE=self-efficacy; DHQ=Diet History Questionnaire; SL=step log; MDs=meal diaries; RU=recipe use
[b] Couple interviews, meal diaries, attendance record and focus groups are process measures.

Figure 3-2. Intervention flow chart

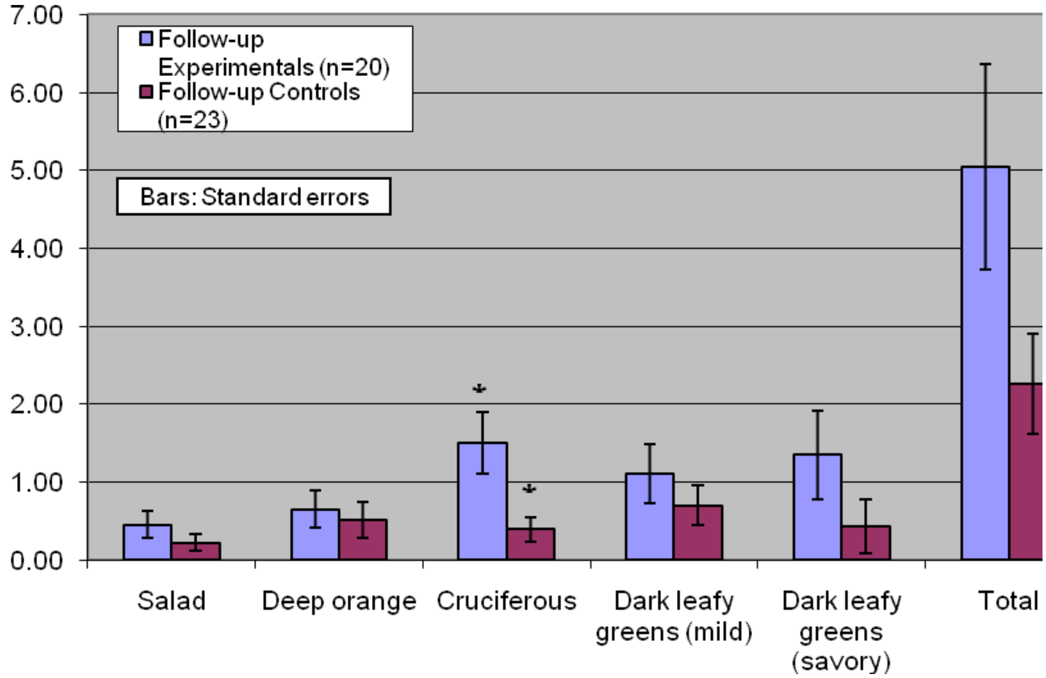


Figure 3-3. Average number of times recipes were made at home since post-test[1,2]

[1] Categories exclude recipes for the following: salads=vegetable chunk salad, fruit salad; cruciferous=broccoli, bean & bowtie pasta salad; leafy greens (mild)=Caesar salad. Total includes 11 recipes (three in each category minus any excluded).
[2] Means exclude experimentals who attended only 0 or 1 lesson.
* Significantly different ($p<0.05$)

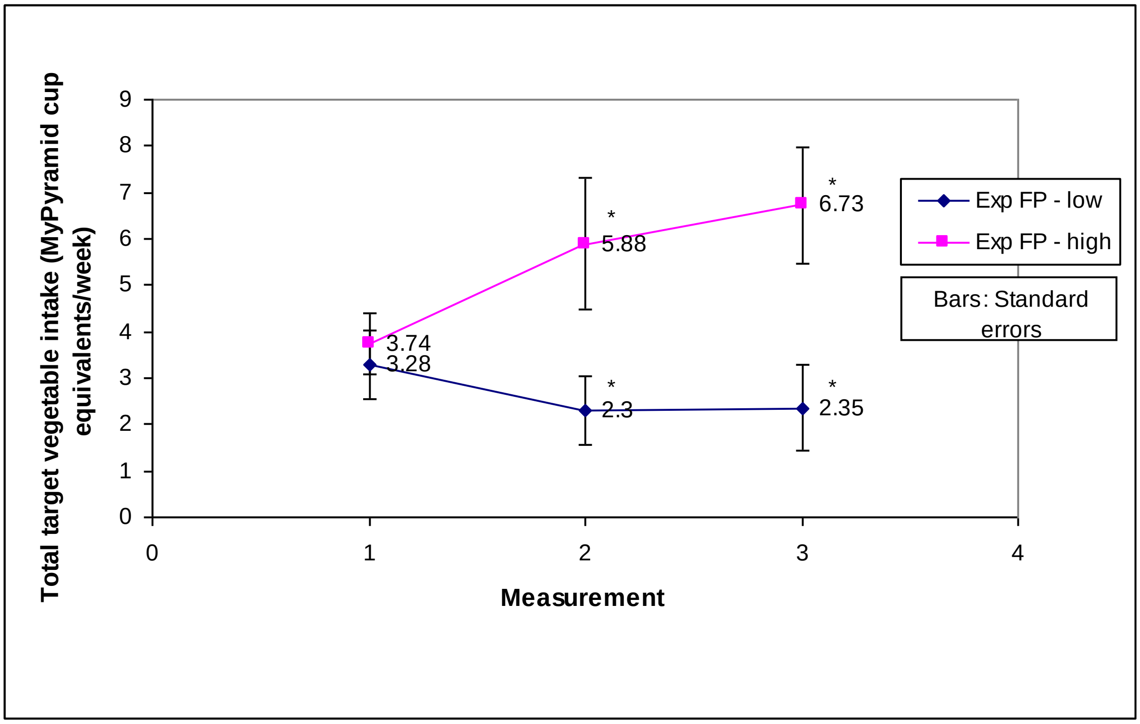


Figure 3-4a. VIA derived total target vegetable intake for experimental food preparers by low/high meal diary score[1,2]

[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=10 low and n=15 high; Measurement 2 (Post-test): n=8 low and n=15 high; Measurement 3 (Follow-up): n=7 low and n=15 high
Significant difference between groups at an assessment point: * (p<0.05); ** (p<0.01); *** (p<0.001)

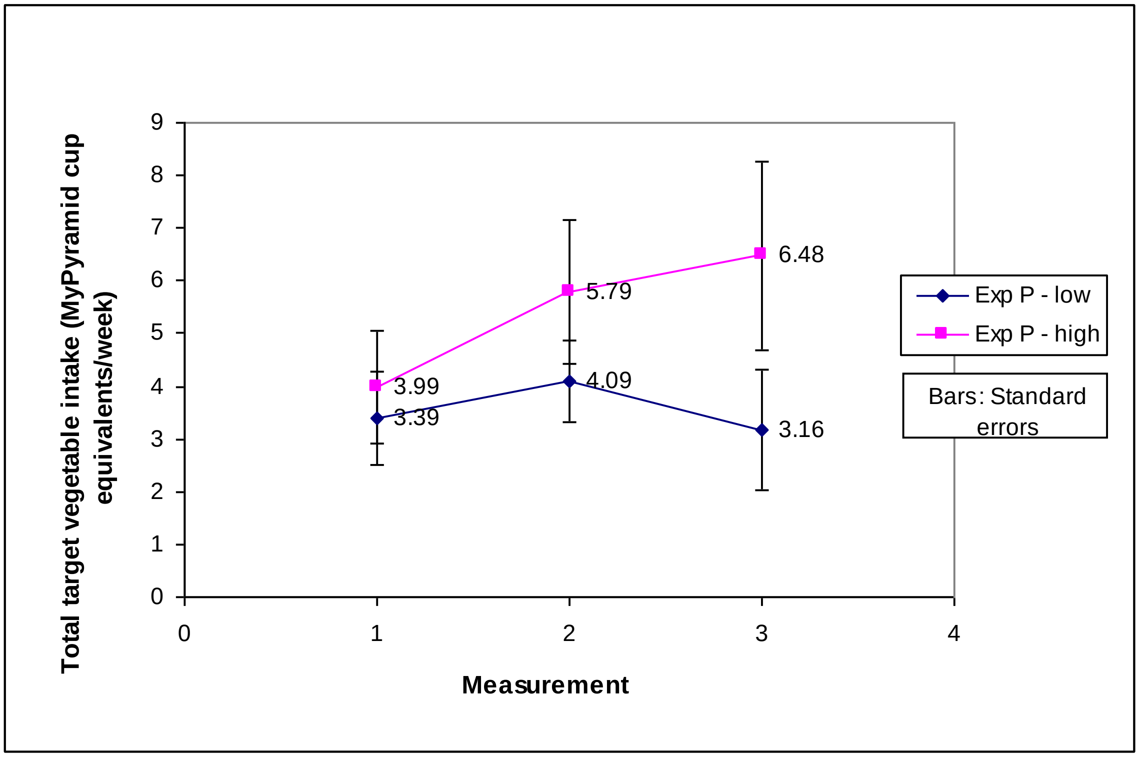


Figure 3-4b. VIA derived total target vegetable intake for experimental partners by low/high meal diary score[1,2]

[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=10 low and n=15 high; Measurement 2 (Post-test): n=8 low and n=15 high; Measurement 3 (Follow-up): n=7 low and n=15 high

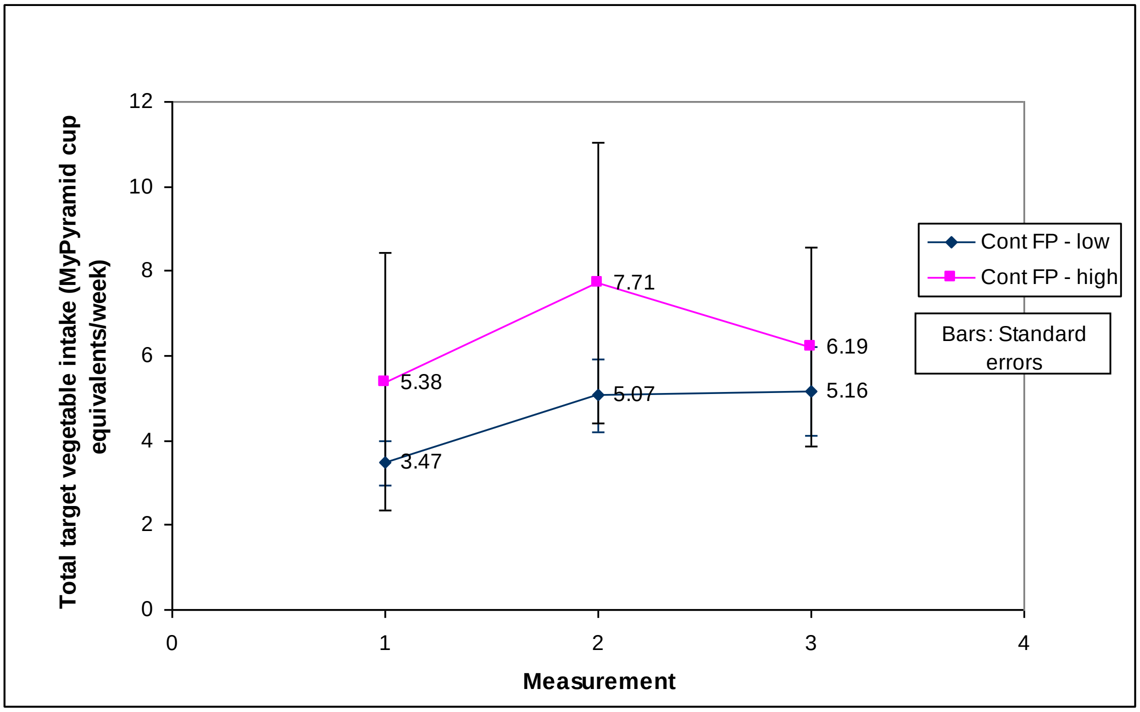


Figure 3-4c. VIA derived total target vegetable intake for control food preparers by low/high meal diary score[1,2]

[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=22 low and n=3 high; Measurement 2 (Post-test): n=19 low and n=3 high; Measurement 3 (Follow-up): n=20 low and n=3 high

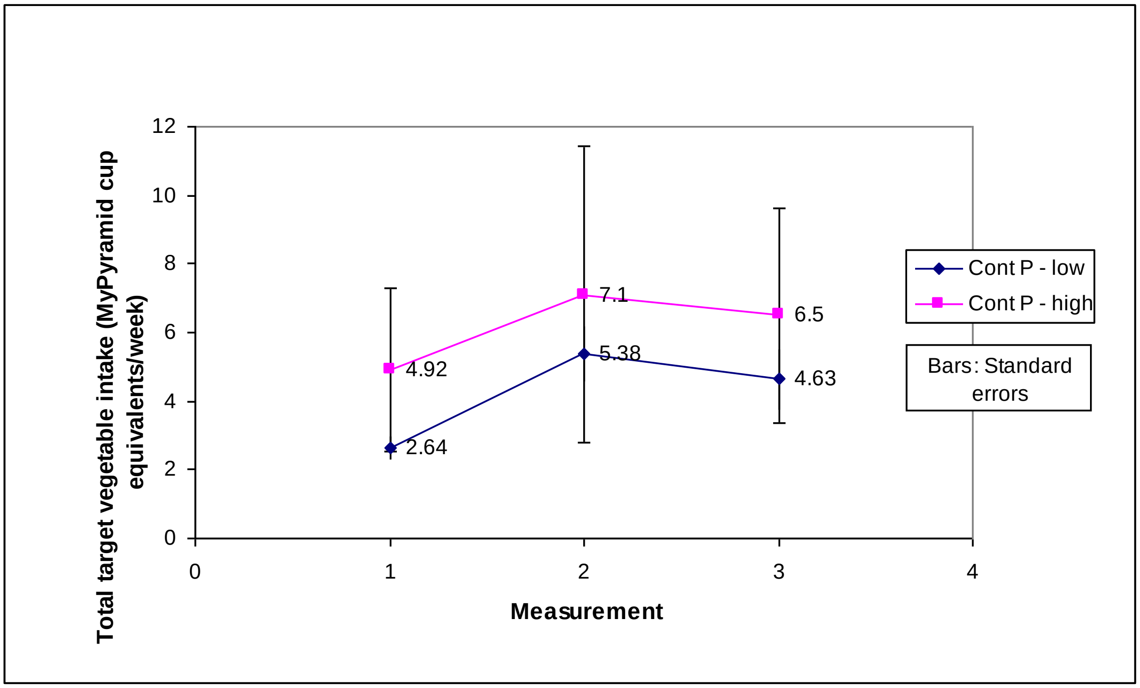


Figure 3-4d. VIA derived total target vegetable intake for control partners by low/high meal diary score[1,2]

[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=22 low and n=3 high; Measurement 2 (Post-test): n=18 low and n=3 high; Measurement 3 (Follow-up): n=19 low and n=3 high

Chapter 4

Discussion and Conclusions

Interventions to increase fruit and vegetable consumption have had modest results (Ammerman et al., 2002; Bowen & Beresford, 2002), and some studies find that it is easier to increase fruit as opposed to vegetable intake (Ammerman et al., 2001; Campbell et al., 1999; Devine et al., 2005; Stables et al., 2002). Nutrition education interventions need to focus on increasing vegetable intake specifically (Stables et al., 2002; Trudeau et al., 1998), especially that of the deep orange, cruciferous, and dark green leafy vegetables. These vegetables are especially protective against cancer and other chronic diseases (Van Duyn & Pivonka, 2000), but their intake by Americans is sub-optimal (Guenther et al., 2006; Johnston et al., 2000).

This research project to increase intake of target vegetables (deep orange, cruciferous and dark green leafy) among our target population (low-income, rural Appalachian families) was composed of two related steps. The first step used focus groups to study the process of vegetable selection within families. The second step designed and evaluated a community-based wellness intervention intended to improve frequency of serving and thus intake of our target vegetables at shared family meals.

Process of Family Vegetable Selection

Studies indicate that the preferences of husbands and children usually determine what foods are served at family meals (Barker et al., 2008; Brown & Miller, 2002; DeVault, 1987; Jansson, 1995; Kerr & Charles, 1986; Pill & Parry, 1989; Stratton & Bromley, 1999). Some women simply adapt by methods such as eliminating foods children and/or partners dislike or by making alternative dishes for themselves (Bove et al., 2003; Brown & Miller, 2002; DeVault, 1987; Krummel et al., 2002). For example, wives may serve fewer foods they prefer such as certain vegetables and serve more foods that their husbands prefer such as meat and potatoes (Bove et al., 2003; Brown & Miller, 2002). But we had little understanding of other factors that influence family member vegetable preferences and patterns, such as past experience and family norms, especially for our target population.

Therefore, the first study of this research project used focus groups to investigate the process of family vegetable selection, especially surrounding our target vegetables. A total of 8 focus groups were conducted – two with each segment (men/women vegetable likers/dislikers). Focus groups were ideal to use because the nature of this research step was exploratory. Other studies on family food choices have used focus groups to gather information from low-income and low-education women (Barker et al., 2008; Damman & Smith, 2009; Wiig & Smith, 2009). However, our study uniquely provided the perspectives of both men and women (as opposed to only women) and vegetable-likers and dislikers. Participants in our study also completed a vegetable intake form to assess intake, frequency of serving, and like/dislike of our target and other popular vegetables.

We used Exchange Theory to guide the focus group questions because, unlike the individually-focused theories commonly used in nutrition research, it offers constructs relevant to family interactions around food choices. It is based on the constructs of rewards (i.e., positive reinforcements), costs (i.e., punishments or loss of rewards), comparison level (based on previous experiences and social norms), and outcomes (reflect the balance of rewards, costs, and comparison level) (Sabatelli & Shehan, 1993). This provided a new perspective on family food choices, as Exchange Theory has only been used to a small extent in nutrition-related research.

Participants in all segments associated more costs than rewards with serving vegetables at family meals. Participants mentioned *costs* that were tangible (i.e., lack of availability or greater expense for some forms, money spent on wasted vegetables, time spent learning new preparation methods and recipes, efforts needed to try new unfamiliar vegetables and introduce flexibility into meal choices), personal (i.e., aversion based on smell, taste and texture; not fulfilling role expectations), and social (i.e., rejection by, objections from, or disagreements with family members based on vegetables served). They were unfamiliar with the majority of our target vegetables and did not know how to prepare them so they would taste good. Other focus group studies with low-income audiences have reported some of these costs were cited as barriers to eating more fruits and vegetables (Reicks et al., 1994; Treiman et al., 1996; Wiig & Smith, 2009). But in contrast to other focus group studies, our focus on the unfamiliar, savory vegetables highlighted the importance of personal aversions and social costs when attempting to change vegetable choices.

Rewards mentioned by participants included personal benefits (i.e., good for your health), positive family member reactions, and lack of conflict. Sweet vegetables (corn, peas and carrots) were the most rewarding vegetables to serve because they were universally liked and did not spark negative comments from family members. While we are unaware of any other American focus group studies that mention this sweetness characteristic, our finding agrees with a Scottish study indicating that sweet vegetables were most acceptable and rewarding to serve (Marshall et al., 1995). Similarly, Dinehart et al. (2006) found that vegetable sweetness positively predicted preference and intake. Even sweetening broccoli and cauliflower by adding sugar increases pleasantness ratings of these vegetables (Capaldi & Privitera, 2008). In our focus groups, we found that meat and potatoes were more rewarding to serve than vegetables. Marshall et al., (1995) similarly found that vegetables were ‘second best’ to meat, especially among low-income participants. Other focus group studies have likewise reported that low-income participants spend large proportions of their food dollars on meat, which they view as an essential component of meals (Bradbard et al., 1997; Wiig & Smith 2009). Low-income focus group participants in another study reported that potatoes were more affordable and "filling" for the family compared to other fruits and vegetables (Shankar & Klassen, 2001).

Intake of the target vegetables was low. Family norms, the expectation that only foods liked by all family members would be served, and previous experiences with family reactions to vegetables led many food preparers to serve only a limited variety of vegetables that were acceptable to all family members, as found in Scottish families (Marshall et al., 1995). Our participants avoided new and unfamiliar vegetables, such as the savory target vegetables, and said that tasting samples at a store or vegetable dishes at a restaurant or social event might inspire serving them at meals.

Results of this focus group study provided several important considerations for designing an intervention for our target audience to increase intake and serving of new vegetables. For example, an intervention should:

1. Give food preparers and their families the opportunity to taste new vegetables raw or in dishes without having to worry about availability or invest their own time or money.

2. Encourage families to negotiate and establish tasting rules for new vegetables. Tasting rules were rarely mentioned among focus group participants but such rules positively correlate with children's consumption of the food that is the target of the rule (Vereecken et al., 2005). A tasting rule might be that all family members present are to take two bites of any new vegetable. This rule could support a new norm that any dish liked by at least two family members could be repeated once or twice a month.

3. Encourage families to form teams (i.e., a parent and a child) that support trying new vegetables on a regular basis and continued serving of a vegetable liked by the team even if other family members do not like it.

4. Provide instruction for growing vegetables in home gardens, as gardening was fairly common among those participating in the focus groups.

Community-Based Wellness Intervention

The second study of this research project was an experimental wellness intervention designed to improve target vegetable intake among food preparers and their partners. The actual target audience of the intervention was food preparers (practically, it would have been very difficult to get both food preparers and partners to attend intervention lessons). However, we also involved partners in the evaluation to assess the extent to which their vegetable intake was altered when the food preparer was "trained" in the intervention. To date, there is no evidence that trained food preparers can change family member vegetable intake, given that other studies only evaluate the intake of the food preparer and not of other family members.

Food preparers were randomized to the experimental or the control treatment. Experimental food preparers were to attend 8 weekly lessons, which were based on Social Cognitive Theory constructs and focused on increasing the intake and serving of the target vegetables at family meals plus choosing low-energy-density foods and increasing physical activity. Lessons were designed to overcome many of the cited barriers to altering food choices and included visual demonstrations, tasting opportunities, comparative data, and handouts (on vegetable tips, growing in home gardens, etc.). Because the focus groups indicated our population lacked familiarity with the target vegetables and wanted to taste them before introducing them at family meals, participants prepared vegetable recipes in class and took them home to serve to their family. Food preparers were encouraged to develop tasting rules at home for the dishes with family members. Control food preparers received 8 weekly mailed packets that included the same handouts and recipes given to experimentals.

Evaluation measures were completed by both food preparers and their partners and included several questionnaires filled out at baseline, immediate post-test, and at 3-month follow-up. Couple interviews, guided by a reciprocal determinism model, were also conducted at baseline and immediate post-test with a random sample from each treatment to further enrich our understanding of participant experiences with the intervention.

Other community interventions targeting low-income populations have used the same basic study design, where participants attend regular meetings aimed at increasing general fruit and vegetable intake (Devine et al., 2005; Havas et al., 1998; Havas et al., 2003; Shankar et al., 2006). These interventions, which did not specifically address our target vegetables, have lasted from three weeks (plus a booster session six weeks later) to six months and have used various theoretical underpinnings including a life-course model, the stage model of change, Social Learning Theory, and the socio-ecological theoretical framework.

Our intervention resulted in few significant differences between original experimental and control treatments in quantitative measures assessed, despite removing the common barriers to changing food choice. Our results imply that providing food preparers with knowledge of health benefits and familiarity and skills to prepare new vegetables; offering ways to reduce cost, time, and effort; and increasing availability by providing free vegetables for classes were not enough to impart a significant change in our target vegetables. Both controls and experimental treatments increased mainly familiar vegetable (broccoli, carrots, dark lettuce) intake during the intervention. While no change was found in either food preparer or partner reports of times served at family meals or personal intake of the target vegetable groups, there was a non-significant trend for experimentals to retain any increase in intake and serving while control intake dropped off.

Other community interventions in which low-income participants attended regular meetings have produced net increases in fruit and vegetable intake ranging from no improvement (Shankar et al., 2006) to 0.4 *servings*/day (Havas et al., 1998; Havas et al., 2003) or 0.8 *times*/day (Devine et al., 2005). Devine et al., (2005), which was the only one of these studies to report fruit and vegetable intake separately, found that the change was due mostly to increased fruit intake while altering vegetable intake proved more difficult. Additionally, these other interventions promoted and reported on all vegetables, while our intervention targeted the less familiar protective vegetables. The other interventions also had larger sample sizes (ranging from about 200 to over 3,000) compared to this study (n=50 food preparers and n=50 partners, analyzed separately). Generally, the smaller the sample size, the larger the change in intake must be in order to be statistically significant.

Our intervention had little impact on quantitative measures of self-efficacy (SE) and readiness-to-eat more vegetables (RE) among food preparers, likely because scores on these validated instruments were very high at baseline leaving little room for advancement post-intervention. However, qualitative data suggested that experimental food preparers increased self-efficacy during the intervention. Among partners there was a nearly significant trend for RE scores to be increased post-intervention in experimental compared to control partners, suggesting the intervention did have some effect on experimental partners. Other interventions with low-income populations have shown positive improvements in intervention participant's SE and/or stage-of-change for eating fruits and vegetables (Block et al., 2004; Havas et al., 1998; Havas et al., 2003; Nitzke et al., 2007). However, while our intervention emphasized the less popular target vegetables (in contrast to the above interventions that targeted fruits and vegetables in general), the validated SE and RE forms we used asked about vegetables in general. They were not specific enough to pick up changes in selection and use of our target vegetables.

The proposed hypotheses for this research, plus whether each was accepted or rejected, are as follows:

A. In comparing trained i.e., experimental (E) versus control (C) food preparers and their partners:

H1. Intake of some target vegetables will be significantly increased in both E food preparers and their partners compared to C food preparers and their partners at post-intervention assessments.

This hypothesis was supported for only a few individual vegetables (squash/pumpkin, cauliflower/Brussels sprouts) among food preparers. This hypothesis was rejected for partners.

H2. Reported frequency of serving of some target vegetables at family meals will be significantly increased in both E food preparers and their partners compared to C food preparers and their partners at post-intervention assessments.

This hypothesis was rejected as no significant differences were found between treatments for food preparers and for partners. We did find that for raw greens, although control partners reported significantly increased serving at post-test compared to baseline intake, this decayed at 3-month follow-up and experimental partner reporting of raw greens increased significantly between post-test and 3-month follow-up.

H3. Mean liking scores of target vegetables will be significantly increased in both E food preparers and their partners compared to C food preparers and their partners at post-intervention assessments.

This hypothesis was rejected for both food preparers and partners. We anticipated that experimentals would increase their liking of some of the target vegetables after having the opportunity to taste them in class (food preparers only) or in recipes sent home (food preparers and partners). But we saw no significant changes in liking scores by treatment between baseline and post-intervention assessments.

H4: Perceived disease risk scores will be significantly increased in both E food preparers and their partners compared to C food preparers and their partners at post-intervention assessments.

This hypothesis was partially supported for food preparers. Experimental food preparers perceived significantly greater personal cancer risk by 3-month follow-up compared to control food preparers. No significant differences between food preparer groups were evident for change in perceived risk of heart disease or high blood pressure, perhaps because these diseases were not stressed as heavily during the lessons. This hypothesis was not supported among partners, likely because they were not directly provided with any information about disease risk.

H5. Stage-of-readiness-to-eat more vegetables will be significantly increased in both E food preparers and their partners compared to C food preparers and their partners at post-intervention assessments.

This hypothesis was rejected for food preparers, where the majority (90%) started in the action and maintenance stages at baseline and therefore had little room to advance post-intervention. Among partners, there was a nearly significant trend ($p=0.062$) for experimentals, but not controls, to move to more advanced stages post-intervention. More support for this hypothesis may have occurred had the validated RE form asked specifically about our target vegetables as opposed to vegetables in general (generic).

B. In comparing trained (E) versus control (C) food preparers (not their partners):

H6: Intake of fiber, vitamins A and C, carotene and lutein will be significantly increased in E compared to C at 3-month follow-up.

This hypothesis was rejected. This finding is not surprising, given that there was very little difference between treatments in change in target vegetable intake (i.e., the target vegetables are good sources of these nutrients).

H7: Self-efficacy (SE) scores will be significantly increased in E compared to C at post-intervention assessments.

This hypothesis was rejected. SE scores were high at baseline and remained high post-intervention for food preparers in both treatments. During interviews, experimental but not control food preparers reported increases in knowledge surrounding the target vegetables and skills in their preparation, indicating an improvement in SE. However, this was not captured quantitatively through the validated SE scale used, likely because it was not specific for the target vegetables but rather asked about 'generic' vegetables. Had we asked about our target vegetables specifically, baseline scores could have been much lower thus leaving more room for improvement.

Our intervention may have attracted an audience with greater than usual self-efficacy for fixing and eating generic fruits and vegetables, as participant baseline SE scores averaged about 2.8 (average of seven questions; range 1 to 3) and they were mainly in the action and maintenance stages-of-change for eating vegetables. For comparison, low-income women in the Maryland WIC 5-A-Day Promotion Program had SE scores for fruits and vegetables of about 15.5 at baseline (total of ten questions; range 0 to 20) (Havas et al., 1998). Low-income young adults in another intervention to increase fruit and vegetable intake had SE scores of about 3 (average of twelve questions; range 1 to 5) at 12-month follow-up (baseline data not reported) (Nitzke et al., 2007). Both the small scale range (1-3), the combining of fruit and vegetable skills within the instrument and the non-specificity of vegetables in this validated questionnaire prevented a more accurate measure of changes in SE in our intervention.

H8: Daily step equivalents will be significantly increased in E compared to C at post-intervention assessments.

This hypothesis was rejected. There was a trend for experimental, but not control, food preparers to increase daily step equivalents. However, very few control food preparers provided this data at all three assessment points (controls reporting data at baseline: n=8; post-test: n=6; 3-month follow-up: n=3).

Although initial analyses yielded few significant differences between original experimental and control treatments, subgroup analysis results are noteworthy. When families were grouped by high and low meal diary scores (a high score indicated both parents and a child tasted or ate at least seven recipes, excluding those from the fruit lesson), we found significantly greater increases in intake and serving frequency of the target vegetables among experimental food preparers with high meal diary scores. This held true for data collected from the VIA (a vegetable intake assessment form that assessed intake and frequency of serving of *target vegetables only*) and trends for intake were verified using data collected from the DHQ (a more comprehensive Diet History Questionnaire that assessed intake only of *all foods and beverages*).

Total target vegetable recipe use at 3-month follow-up was also significantly higher among experimental food preparers with high meal diary scores compared to those with low meal diary scores. Similar patterns for intake and frequency of serving were seen among experimental partners, with two of three measures of intake data showing significantly greater increases among experimental partners with high versus those with low meal diary scores.

Having to complete the meal diary appeared to motivate some food preparers to negotiate family member involvement in tasting dishes brought home. We are unaware of such a reporting tool being used in other interventions. Although methods or tools that inspire intra-family negotiation are usually not dealt with in traditional nutrition education interventions, they appear vital for fostering change in family choices of new vegetables.

Limitations

This research had limitations:

1. Samples were small and taken from three rural Appalachian counties in Central Pennsylvania. The focus group participants were recruited from two neighboring counties (Snyder and Northumberland) and the intervention was conducted with participants recruited in Centre County. Our participants may not represent the diversity of low-income families from other Appalachian and US regions. However, they were representative of the ethnic diversity in our study region. Our sample was 94% white while the latest figures from the US Census Bureau (2006-2008) indicate that the three counties where we held the studies are also largely white (Northumberland County is 96% white; Snyder County is 97% white; Centre County is 90% white; the average of the three counties is 94%).

2. Several factors could have increased the likelihood that participants gave socially desirable responses. In the first study, the focus group setting could have influenced what people would voluntarily share (although this should have been minimized through group stratification). In the second study, the same researcher conducted both the intervention and the couple interviews. However, the intervention focus groups were done by someone not involved in the presentation. In both the first and second studies, quantitative data (i.e., vegetable intake) were self-reported, although this is typical in community–based studies that assess dietary intake.

3. The self-selected sample of food preparers in the intervention consumed more total vegetables than the national average at baseline. However, like most Americans, they were not consuming the variety of vegetables recommend at baseline. Food preparers also had high self-efficacy scores and were in the more advanced stages of readiness-to-eat more vegetables. However, because the intervention and recruiting materials were aimed at those in the preparation and action stages, we expected fewer volunteers in the less advanced pre-contemplation and contemplation stages.

4. Some of our forms were either not validated (i.e., the VIA) or were validated but were not specific for our target vegetables (i.e., RE and SE forms). Although the VIA was not validated, we were able to compare results obtained from it with results obtained from the validated DHQ. The VIA and DHQ asked about intake over different time frames (previous month versus past 6 months, respectively), which probably introduced some variation in responses. Nevertheless, correlation coefficients were 0.6 or better for the 8/10 questions on the VIA taken verbatim from the DHQ, suggesting the ability of the

VIA is sufficiently similar to that of the DHQ to record patterns of change in target vegetable intake.

Contributions

This research made many unique contributions to the field:

1. Our research focused on the less popular vegetables from the deep orange, cruciferous, and dark green leafy vegetable families. We are unaware of any other interventions that have focused on just these protective vegetables. Our experimental intervention used appropriate theory and adult learning techniques. The lack of significant differences in intake by the original intervention treatment groupings suggests that it is very difficult to increase intake of most of these unfamiliar vegetables. Given that both treatments reported increases in intake and serving of the target vegetables, it is likely that just filling out the instruments produced a Hawthorne effect and the resulting socially desirable responses. When increases were reported, it was predominately for those vegetables participants already ate and served namely carrots, broccoli and dark lettuce.

2. The focus groups provided perspectives of both vegetable-likers and vegetable-dislikers and men and women (as opposed to only women). Stratifying the groups by sex and vegetable-liking status allowed us to compare any differences between these groups. Surprisingly, vegetable-liker/disliker status and sex made little difference in our findings. Participants in all segments saw more costs than rewards to serving vegetables. The intra-family norm was to serve only a limited variety of vegetables that were acceptable to everyone, while our target vegetables were largely ignored due to their unfamiliarity.

However, our focus on the unfamiliar target vegetables illuminated how personal preferences and social costs affected what was served. We also demonstrated the usefulness of Exchange Theory in examining food choices for family meals.

3. The experimental intervention provided feedback from food preparers and their partners. It is typically assumed that if the female food preparer is given the necessary knowledge and skills, she can bring about change in family member food choices. However, this is the first study to examine how partner vegetable intake is affected by food preparer training, as generally only food preparer intake is assessed. Food preparers and partners in both treatments increased intake and reported more serving of the target vegetables over time. Partner reports usually mirrored those of the food preparers with often greater variance, perhaps because they were less aware of what was being served. But because this seemed to reflect social desirability rather than true intake or frequency of serving, the impact on partners is not clear from the original experimental groups. However, there was a nearly significant trend for experimental partners to progress into more advanced RE stages at post-intervention assessments compared to controls, who regressed to less advanced RE stages by 3-month follow-up. This suggests some shift in partner willingness to experiment with new vegetables may have been promoted by the experimental treatment. When results for high and low meal diary score groups were examined, it was apparent that food preparers did make significant changes in both intake and serving frequency. Significant changes were evident among partners for two of three measures of intake but not for serving frequency. The actual impact of food preparer training on partner reports of intake and frequency of serving needs further clarification. Thus, only food preparers in certain family situations may be able to promote food choice change in their partners. In other words, high meal diary scores may be markers for

families where the food preparer had the power or the desire to engage the partner and children in tasting.

4. The intervention allowed food preparers to leave meetings with actual prepared dishes instead of recipes and their ingredients. Unlike other interventions that provide just recipes and ingredients, our strategy facilitated family members trying the dishes at home (i.e., food preparers could not filter out the already familiar ingredients for use in other already familiar dishes). Feedback on this process provided insight into the intra-family factors affecting acceptance of the vegetables. Although we had hoped providing prepared dishes would promote adoption, we instead found key intra-family barriers that must first be overcome. These findings can be related to Exchange Theory constructs. The *norm* continued of partners and children driving dinner vegetable choices, while food preparers continued to fulfill *role expectations* by preparing only those vegetable dishes the family would like. Experimentation with new vegetables (the desired *outcome*) was still limited in many families if the partner or children provided negative feedback (i.e., the *costs* were high while *rewards* were low).

5. Results of subgroup analysis suggest that the meal diary could be viewed as either a) a potential tool to help the food preparer negotiate with family members to taste and evaluate recipes or b) a decision-making tool that could help the food preparer determine recipes or ways to use the vegetables in other recipes that were acceptable to family members.

6. Our findings highlight the importance of parents establishing tasting opportunities for unfamiliar vegetables for children and other adults. Rules about tasting rather than

outright rejection of anything new that apply to both parents and children may help the food preparer introduce new vegetable choices. Some experimental participants reported that children liked the appearance of new foods every week, even if they might not have been fond of a particular dish. Parents could be advised to build on the idea of novelty in dinner offerings.

Implications for Future Research and Practice

Future interventions designed to increase vegetable variety may consider the following:

1. Use Baranowski and Hearn’s (1997) reciprocal determinism model in the design and evaluation of interventions. As we found in this study, food preparers do not make decisions about food choices independent of the influence of other family members. Family member food preferences play a major role in determining family food choices and thus need to be considered in an intervention’s design and evaluation. This model is a comprehensive framework that provides constructs relating the interaction between family member’s personal characteristics and family characteristics and how this interaction influences food choice.

2. Teach intra-family negotiation methods to the food preparer early in the intervention. Reexamine the utility of the meal diary in a larger sample with more emphasis on family use.

3. Discuss ways to and then motivate food preparers to develop family tasting rules for new dishes. Encourage participants to form role-modeling teams with their partners that

support evaluating new recipes on a regular basis. If adult figures are positive about tasting new dishes, children may be more willing to do so. Participants could be encouraged to repeat recipes liked by two or more family members at least once a month. This lessens the power of a single picky family member to veto a new dish.

4. Evaluating who has the most power or influence over vegetable choices for family meals is a challenge. We found this reflects not who makes food choice decisions in the grocery store, but rather what that person considers in making that decision. Two methods could be used to determine whose preferences are dominant: a) couple interviews or parent and child interviews and b) having food preparers review recipes and provide reasons for rejection or acceptance. A person not involved with presenting the intervention should conduct these measures. A scale to assess family member influence on food choices could be developed, but it would be difficult to persuade all family members to be truthful about this due to gendered role expectations and parental unwillingness to reveal the power of children.

5. Develop and validate self-efficacy and readiness-to-eat instruments specific for the vegetables being targeted.

6. Include repeated 24-hour recalls in the assessment of target vegetable intake. Recalls may be less prone to social desirability bias than a FFQ. This, coupled with a larger sample size, may be better able to pick up significant intervention effects.

7. Validate the VIA by comparing intake estimates with a gold standard (i.e., 24-hour recalls or food records).

8. Present multiple options for using heat and serve vegetables in already familiar recipes.

   Many participants preferred heat and serve vegetables to the use of even simple recipes.

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Appendix A

Baseline DHQ & VIA derived target vegetable intake for food preparers - regular serving sizes

	Exp/DHQ (n=25)	Cont/DHQ (n=25)		Exp/VIA (n=25)	Cont/VIA (n=25)	Spearman Correlation Coefficients[a] comparing assessment by DHQ and VIA
	servings/week (mean±std dev)					
Carrots	1.19±1.48	0.95±1.67		1.56±1.94	1.23±2.01	0.80**
Squash/Pumpkin[b]	0.10±0.27	0.15±0.29		0.12±0.36	0.04±0.13	0.37**
Sweet Potatoes	0.38±1.17	0.41±0.67		0.23±0.44	0.51±0.88	0.84**
Deep orange total	1.67±1.90	1.52±2.01		1.90±2.18	1.78±2.53	0.74**
Broccoli	1.85±2.89	2.23±2.07		1.44±1.06	1.97±1.66	0.60**
Cabbage/ Sauerkraut	0.32±0.72	0.37±0.59		0.39±0.83	0.36±0.51	0.76**
Cauliflower/ Brussels sprouts[c]	0.27±0.30	0.73±0.74		0.54±1.00	0.44±0.56	0.64**
Cole Slaw	0.19±0.27	0.33±0.69		0.29±0.30	0.44±0.95	0.79**
Cruciferous total	2.62±3.14	3.67±2.87		2.66±1.94	3.21±2.67	0.59**
Cooked Greens	0.38±0.98	0.41±1.19		0.56±1.46	0.25±0.57	0.74**
Dark Lettuce[d]				1.76±2.50	2.06±2.15	0.57**
Lettuce salads[d]	2.76±3.46	3.07±2.84				
Raw Greens	0.61±1.22	0.23±0.53		0.41±0.73	0.25±0.85	0.80**
Dark green leafy total	3.76±4.26	3.71±3.70		2.73±3.89	2.56±2.68	0.62**

[a] For square-root transformed vegetable intakes (n=50).
[b] Due to error, squash/pumpkin portion size options on the VIA were each ¼ cup less than those on the DHQ. However they were scored as if identical to the DHQ.
[c] Intake of cauliflower/Brussels sprouts was significantly different between experimental and control groups as measured by DHQ (t=-2.309; p=0.026).
[d] The DHQ assessed intake of 'lettuce salads' (i.e., any type of lettuce). The VIA specifically assessed intake of 'dark lettuce like red leaf and romaine' (not including iceberg), as lighter leaf lettuce was not among our vegetables of interest.
* Correlation is significant at the 0.05 level (two-tailed); ** Correlation is significant at the 0.01 level (two-tailed)

Appendix B

DHQ derived target vegetable intake (means ± SD) – regular serving sizes

	Measurement[a]	Experimental	Control
Personal Intake (servings/week)			
Carrots	Baseline	1.19±1.48	0.95±1.67
		--	--
	Follow-up	1.53±1.89	2.01±2.56
Squash/pumpkin	Baseline	0.10±0.27	0.15±0.29
		--	--
	Follow-up	0.25±0.35	0.11±0.18
Sweet potatoes	Baseline	0.38±1.17	0.41±0.67
		--	--
	Follow-up	0.45±0.64	0.45±0.82
Deep orange total	Baseline	1.67±1.90	1.52±2.01
		--	--
	Follow-up	2.23±2.20	2.58±2.94
Broccoli	Baseline	1.85±2.89	2.23±2.07
		--	--
	Follow-up	1.75±1.78	2.64±2.06
Cabbage/sauerkraut	Baseline	0.32±0.72	0.37±0.59
		--	--
	Follow-up	0.19±0.32	0.46±0.73
Cauliflower/Brussels sprouts	Baseline	0.27±0.30	0.73±0.74
		--	--
	Follow-up	0.73±1.02	0.67±0.62
Cole slaw	Baseline	0.19±0.27	0.33±0.69
		--	--
	Follow-up	0.30±0.61	0.38±0.92
Cruciferous total	Baseline	2.62±3.14	3.67±2.87
		--	--
	Follow-up	2.97±2.60	4.16±3.20
Cooked greens	Baseline	0.38±0.98	0.41±1.19
		--	--
	Follow-up	0.62±0.98	0.73±1.51
Lettuce salads	Baseline	2.76±3.46	3.07±2.84
		--	--
	Follow-up	3.09±5.92	2.95±2.94
Raw greens	Baseline	0.61±1.22	0.23±0.53
		--	--
	Follow-up	0.76±1.12	0.70±1.62

Dark green leafy total	Baseline	3.76+4.26	3.71+3.70
		--	--
	Follow-up	4.46+6.83	4.38+4.63
Total target	Baseline	8.05+8.50	8.89+6.26
		--	--
	Follow-up	9.66+9.84	11.11+8.35
Total – C,B,L	Baseline	2.25+2.56	2.64+2.33
		--	--
	Follow-up	3.30+2.97	3.51+3.67
Total in recipes	Baseline	1.75+2.36	1.93+1.97
		--	--
	Follow-up	2.80+2.71	2.67+3.25

[a] Baseline: n=25 experimentals and n=25 controls; Follow-up: n=22 experimentals and n=23 controls.

Appendix C

VIA derived target vegetable intake for food preparers (means ± SD) – regular serving sizes

	Measurement[a]	Experimental	Control
Personal Intake (servings/week)			
Carrots	Baseline	1.56±1.94	1.23±2.01
	Post-test	1.63±1.64	1.59±2.33
	Follow-up	1.91±2.74	1.94±2.36
Squash/pumpkin	Baseline	0.12±0.36	0.04±0.13
	Post-test	0.29±0.62	0.17±0.27
	Follow-up	0.21±0.59	0.09±0.17
Sweet potatoes	Baseline	0.23±0.44	0.51±0.88
	Post-test	0.46±0.75	0.51±0.60
	Follow-up	0.50±1.05	0.36±0.48
Deep orange total	Baseline	1.90±2.18	1.78±2.53
	Post-test	2.38±2.26	2.26±2.72
	Follow-up	2.62±3.26	2.39±2.73
Broccoli	Baseline	1.44±1.06	1.97±1.66
	Post-test	2.03±2.36	2.53±1.93
	Follow-up	1.92±2.32	3.01±2.54
Cabbage/sauerkraut	Baseline	0.39±0.83	0.36±0.51
	Post-test	0.23±0.42	0.45±0.55
	Follow-up	0.24±0.39	0.44±0.74
Cauliflower/Brussels sprouts	Baseline	0.54±1.00	0.44±0.56
	Post-test	1.07±1.62	0.75±0.96
	Follow-up	0.75±1.04	0.46±0.62
Cole slaw	Baseline	0.29±0.30	0.44±0.95
	Post-test	0.23±0.27	0.45±1.28
	Follow-up	0.33±0.45	0.66±1.44
Cruciferous total	Baseline	2.66±1.94	3.21±2.67
	Post-test	3.57±3.80	4.18±3.08
	Follow-up	3.27±3.18	4.61±4.01
Cooked greens	Baseline	0.56±1.46	0.25±0.57
	Post-test	0.82±1.25	0.79±1.28
	Follow-up	0.84±1.44	0.86±2.09
Dark Lettuce	Baseline	1.76±2.50	2.06±2.15
	Post-test	2.43±3.55	3.02±4.03
	Follow-up	3.17±4.38	2.54±3.23
Raw greens	Baseline	0.41±0.73	0.25±0.85
	Post-test	0.31±0.50	0.80±1.35
	Follow-up	1.06±1.45	0.44±0.89

Dark green leafy total	Baseline	2.73+3.89	2.56+2.68
	Post-test	3.55+5.05	4.62+6.06
	Follow-up	5.07+6.36	3.84+4.91
Total target	Baseline	7.29+5.10	7.55+5.72
	Post-test	9.50+9.96	11.06+8.35
	Follow-up	10.96+9.88	10.84+9.07
Total – C,B,L	Baseline	2.53+2.12	2.29+2.06
	Post-test	3.41+4.18	3.93+2.95
	Follow-up	3.96+3.94	3.35+3.71
Total in recipes	Baseline	1.85+1.90	1.49+1.65
	Post-test	2.94+4.11	3.02+2.90
	Follow-up	3.37+3.78	2.21+2.98

[a] Food Preparers: Baseline: n=25 experimentals and n=25 controls; Post-test: n=23 experimentals and n=22 controls; Follow-up: n=22 experimentals and n=23 controls.

Appendix D

VIA derived target vegetable intake for partners (means + SD) – regular serving sizes

	Measurement[a]	Experimental	Control
Personal Intake (servings/week)			
Carrots	Baseline	1.10+1.24	1.04+1.61
	Post-test	2.40+3.92	1.23+1.49
	Follow-up	2.55+4.08	1.07+1.63
Squash/pumpkin	Baseline	0.14+0.37	0.18+0.55
	Post-test	0.22+0.35	0.31+0.63
	Follow-up	0.25+1.06	0.04+0.15
Sweet potatoes	Baseline	0.19+0.37	0.20+0.28
	Post-test	0.52+0.63	0.89+1.54
	Follow-up	0.55+1.49	0.31+0.49
Deep orange total	Baseline	1.44+1.28	1.42+1.90
	Post-test	3.13+3.92	2.43+2.57
	Follow-up	3.35+4.55	1.42+2.01
Broccoli	Baseline	2.41+2.93	1.42+1.47
	Post-test	2.92+2.33	2.98+2.45
	Follow-up	3.18+4.74	2.23+1.96
Cabbage/sauerkraut	Baseline	0.57+0.90	0.37+0.55
	Post-test	0.37+0.48	0.57+0.69
	Follow-up	0.18+0.26	0.62+1.34
Cauliflower/Brussels sprouts	Baseline	0.36+0.50	0.41+0.47
	Post-test	0.90+1.29	0.71+0.75
	Follow-up	0.96+1.57	0.50+0.74
Cole slaw	Baseline	0.20+0.25	0.33+0.45
	Post-test	0.27+0.45	0.28+0.41
	Follow-up	0.26+0.28	0.53+0.50
Cruciferous total	Baseline	3.54+3.47	2.54+2.10
	Post-test	4.46+3.44	4.55+2.87
	Follow-up	4.58+6.00	3.88+2.92
Cooked greens	Baseline	0.78+1.76	0.31+0.63
	Post-test	1.42+2.14	0.79+1.27
	Follow-up	1.05+1.99	0.35+0.60
Dark Lettuce	Baseline	1.60+3.01	1.32+2.31
	Post-test	1.76+2.78	2.97+3.73
	Follow-up	1.76+2.21	3.75+6.83

Raw greens	Baseline	0.73±1.90	0.46±1.42
	Post-test	0.35±0.71	1.18±2.85
	Follow-up	0.75±1.29	0.77±1.56
Dark green leafy total	Baseline	3.10±5.57	2.10±2.68
	Post-test	3.52±4.53	4.93±5.63
	Follow-up	3.56±4.74	4.87±7.20
Total target	Baseline	8.08±8.00	6.05±4.79
	Post-test	11.11±9.70	11.91±8.91
	Follow-up	11.49±13.05	10.17±8.80
Total – C,B,L	Baseline	2.97±3.23	2.26±1.83
	Post-test	4.04±4.07	4.73±4.71
	Follow-up	4.00±4.55	3.12±2.98
Total in recipes	Baseline	2.20±2.97	1.57±1.75
	Post-test	3.40±3.71	3.87±4.82
	Follow-up	3.56±4.53	1.97±2.41

[a] Baseline: n=25 experimentals and n=25 controls; Post-test: n=23 experimentals and n=21 controls; Follow-up: n=22 experimentals and n=22 controls.

Appendix E

Lesson content, handouts, activities, and recipes

Lesson	Content	Handouts, Activities, and Recipes
1	**Introduction/Low-Energy-Density Eating and Portion Sizes** - Purpose of lessons and importance of participation - Low-energy-density eating - Portion control - Recipe preparation (salads)	Handout(s): - Volumetrics handout Activities: - Measure snack portion sizes - Compare volume and calorie content of dried cranberries and cranberry juice - Demonstrate strategies for portion control (multiple serving versus single serving packages, eating from small versus large plates and bowls) Recipes: - Sweet and sour leafy green salad - Fruit salad - Vegetable chunk salad
2	**Physical Activity** - Physical activity PowerPoint	Handout(s): - How is my activity rate? - Are you running scared about physical activity? - Fifteen Ways to Get Moving Activities: - Determine resting and moderate level heart rate
3	**Deep Orange Vegetables** - Nutritional value - Choosing, storing and preparing - Introducing to others - Recipe preparation	Handout(s): - Growing Deep Orange Vegetables - Deep Colored Vegetable Tips Activities: - Match squash with correct name labels - Demonstrate the difference between carving and cooking pumpkins - Compare various forms (fresh, frozen, canned) - Taste roasted pumpkin seeds Recipes: - Pumpkin custard - Sweet potatoes baked with lemon - Squash puff
4	**Cruciferous Vegetables** - Nutritional value - Choosing, storing and	Handout(s): - Growing Cruciferous Vegetables - Cruciferous Vegetables Tips

	preparing - Introducing to others - Recipe preparation	Activities: - Taste raw broccoli and cauliflower, Brussels sprouts prepared three ways - Demonstrate how to prepare fresh Brussels sprouts - Compare various forms (fresh, frozen) - Demonstrate cooking cauliflower with walnut to reduce smell Recipes: - Broccoli, bean and bowtie pasta salad - Roasted garlic cauliflower - Shredded Brussels sprouts with bacon & onions
5	**Fruit** - Nutritional value - Choosing, storing and preparing - Recipe preparation	Handout(s): - Eat Your Colors! - Picking Your Own Fruit - Freezing Fruit at Home - Berries Tips Activities: - Taste fresh papaya, room temperature and refrigerated berries, dried cherries, fruit and meat dish - Compare various forms (fresh, frozen, canned) Recipes: - Pineapple-raspberry parfaits - No-crust strawberry pie - Blueberry crumble
6	**Dark Green Leafy Vegetables - Mild** - Nutritional value - Choosing, storing and preparing - Introducing to others - Recipe preparation	Handout(s): - Growing Green Leafy Vegetables Activities: - Taste raw spinach, dark colored lettuce, kale and chard - Compare various forms (fresh, frozen, canned) - Demonstrate how to use paper towel to keep bagged salad fresh longer - Demonstrate how to wash greens and spin dry Recipes: - Sautéed kale with bacon and vinegar - Spinach skillet - Caesar salad

7	**Dark Green Leafy Vegetables - Savory** - Nutritional value - Choosing, storing and preparing - Introducing to others - Recipe preparation	Handout(s): - Green Leafy Vegetables Tips Activities: - Taste raw collard, mustard, turnip and beet greens - Demonstrate removing tough stems from greens Recipes: - Winter greens and potatoes - Braised mustard greens - Caldo verde
8	**Wrap-Up** - Review of first seven lessons - Focus group discussion - Meal incorporating vegetable and fruit dishes	

Appendix F

DHQ derived total vegetable intake (means ± SD)

	Measurement[b]	Experimental	Control	Effect	*P*
Personal Intake[a] (MyPyramid cup equivalents/week)					
Total vegetables[c] – *per week*	Baseline	6.88±5.42	8.52±6.31	Group	0.265
		--	--	Time	0.574
	Follow-up	7.45±5.52	8.94±5.90	Group x Time	0.954
Total vegetables[c] – *per day*	Baseline	0.98±0.77	1.22±0.90	Group	0.265
		--	--	Time	0.574
	Follow-up	1.06±0.79	1.28±0.84	Group x Time	0.954
Total vegetables[d] (add potatoes, corn, peas) – *per week*	Baseline	10.06±6.01	11.62±6.62	Group	0.394
		--	--	Time	0.580
	Follow-up	10.09±6.55	11.02±6.09	Group x Time	0.719
Total vegetables[d] (add potatoes, corn, peas) – *per day*	Baseline	1.44±0.86	1.66±0.95	Group	0.394
		--	--	Time	0.580
	Follow-up	1.44±0.94	1.57±0.87	Group x Time	0.719
Total vegetables[e] (all including mixed dishes) – *per week*	Baseline	12.59±6.58	14.68±7.17	Group	0.426
		--	--	Time	0.482
	Follow-up	13.20±8.55	13.46±6.60	Group x Time	0.391
Total vegetables[e] (all including mixed dishes) – *per day*	Baseline	1.80±0.94	2.10±1.02	Group	0.426
		--	--	Time	0.482
	Follow-up	1.89±1.22	1.92±0.94	Group x Time	0.391

a Data were square root transformed for analysis.
b Baseline = n=25 experimentals and n=25 controls; Follow-up: n=22 experimentals and n=23 controls
c Includes the following vegetables:

Carrots, squash/pumpkin, sweet potatoes
Cooked greens, lettuce, raw greens
Broccoli, cabbage, cauliflower, coleslaw
Green beans, mixed vegetables, onions, other kinds of veg, peppers, tomatoes

d Includes all vegetables listed in ‘c’, plus potatoes, corn and peas
e Total of all vegetables from DietCalc (i.e., all vegetables listed in ‘d’ plus those found in mixed dishes such as soups, stews, pasta salad, etc.). Does not include legumes (dry beans).

Appendix G

Change in DHQ derived total vegetable intake based on meal diary score (number of recipes for which total family score was 5 or 6;[a-c] means ± SD)

		Meal diary score			
	Measurement[b]	0 to 6 (low)	7 to 15 (high)	Effect	*P* [f]
Personal Intake[d] (MyPyramid cup equivalents/week)					
Food Preparers – Experimental					
DHQ derived total vegetable intake	Baseline	10.89±4.19	13.72±7.71	Group	0.212
				Time	0.727
	Follow-up	10.00±4.18	14.69±9.73	Group x Time	0.280
Food Preparers – Control					
DHQ derived total vegetable intake	Baseline	14.67±7.31	14.79±7.45	Group	0.673
				Time	0.860
	Follow-up	13.20±7.00	16.17±2.87	Group x Time	0.557

[a] For each recipe, scores of 0=refused; 1=tasted; 2=ate were assigned to each of three family members, the food preparer, partner and a child. These scores were summed to provide a total family score ranging from 0 to 6 for each recipe. A total family score of 5 for a recipe meant two parents and a child all tasted it and two ate it; a score of 6 meant they all tasted it and ate it. Example, if a food preparer and partner ate and a child tasted a recipe, the total family score for that recipe is 2+2+1=5.
[b] The score of '0' for 'Number of recipes' includes experimental and control non-responders.
[c] Considers 15 recipes (all intervention recipes except the three fruit lesson recipes).
[d] Data were square root transformed for analysis. All vegetables calculated from DietCalc (includes individual vegetables such as carrots, green beans, mixed vegetables, potatoes, corn, peas, plus those in mixed dishes). Does not include dry beans.
[e] Experimental: Baseline: n=10 low-score (LS) and n=15 high-score (HS); Follow-up: n=7 LS and n=15 HS.
Control: Baseline: n=22 LS and n=3 HS; Follow-up: n=20 LS and n=3 HS.
[f] P values were derived from a linear mixed model analysis with repeated measures.

Appendix H

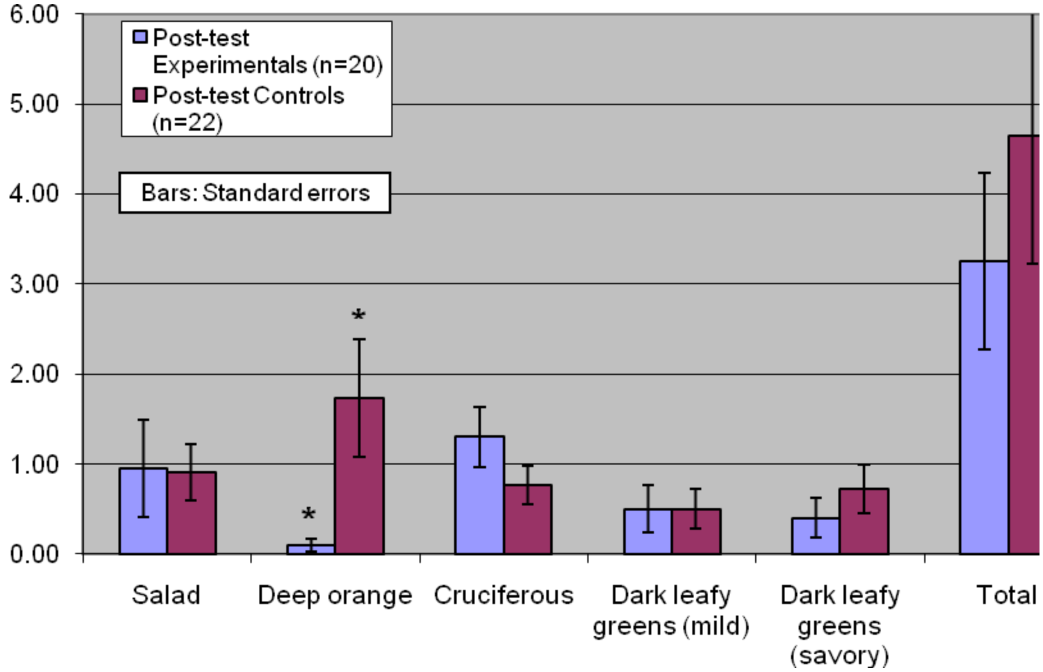
Change in energy (kcal) intake from DHQ based on meal diary score (number of recipes for which total family score was 5 or 6;[a-c] means ± SD)

		Meal diary score			
	Measurement[d]	0 to 6 (low)	7 to 15 (high)	Effect	*P*[e]
Food Preparers – Experimental					
Energy - kcal	Baseline	1748±785	1893±695	Group	0.543
				Time	0.061
	Follow-up	1706±738	1736±702	Group x Time	0.745
Food Preparers – Control					
Energy - kcal	Baseline	2127±763	1530±620	Group	0.343
				Time	0.912
	Follow-up	1981±762	1745±221	Group x Time	0.301

[a] For each recipe, scores of 0=refused; 1=tasted; 2=ate were assigned to each of three family members, the food preparer, partner and a child. These scores were summed to provide a total family score ranging from 0 to 6 for each recipe. A total family score of 5 for a recipe meant two parents and a child all tasted it and two ate it; a score of 6 meant they all tasted it and ate it. Example, if a food preparer and partner ate and a child tasted a recipe, the total family score for that recipe is 2+2+1=5.
[b] The score of '0' for 'Number of recipes' includes experimental and control non-responders.
[c] Considers 15 recipes (all intervention recipes except the three fruit lesson recipes).
[d] Experimental: Baseline: n=10 low-score (LS) and n=15 high-score (HS); Follow-up: n=7 LS and n=15 HS.
Control: Baseline: n=22 LS and n=3 HS; Follow-up: n=20 LS and n=3 HS.
[e] P values were derived from a linear mixed model analysis with repeated measures.

Appendix I

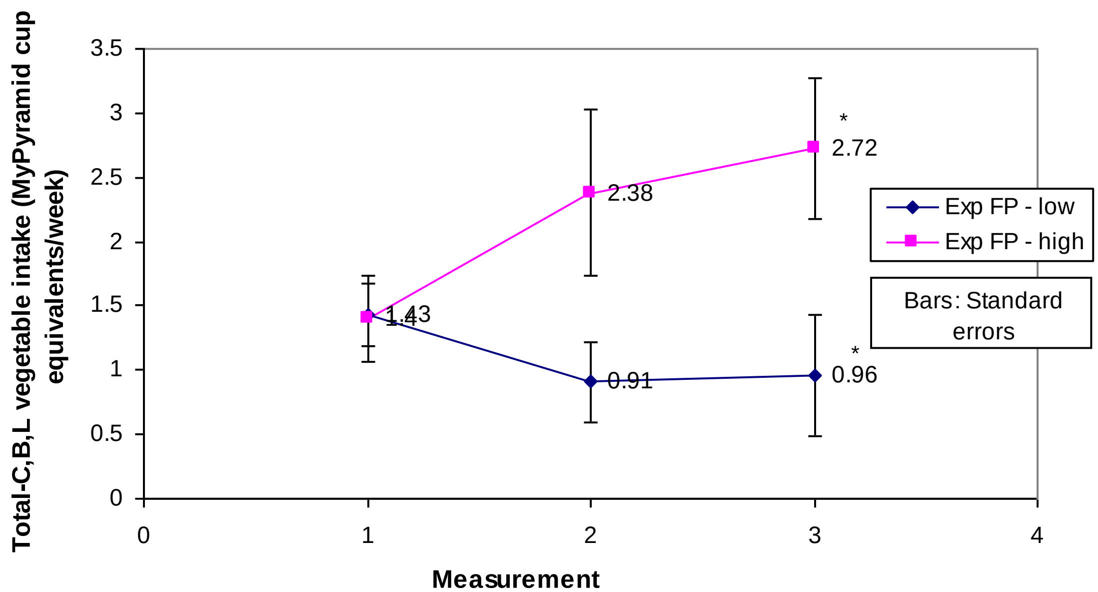
Average number of times recipes were made at home since they were received (doesn't include times made in class for experimentals)[1,2]



[1] Categories exclude recipes for the following: salads=vegetable chunk salad, fruit salad; cruciferous=broccoli, bean & bowtie pasta salad; leafy greens (mild)=Caesar salad. Total includes 11 recipes (three in each category minus any excluded).
[2] Means exclude experimentals who attended only 0 or 1 lesson.
* Significantly different ($p \leq 0.05$)

Appendix J

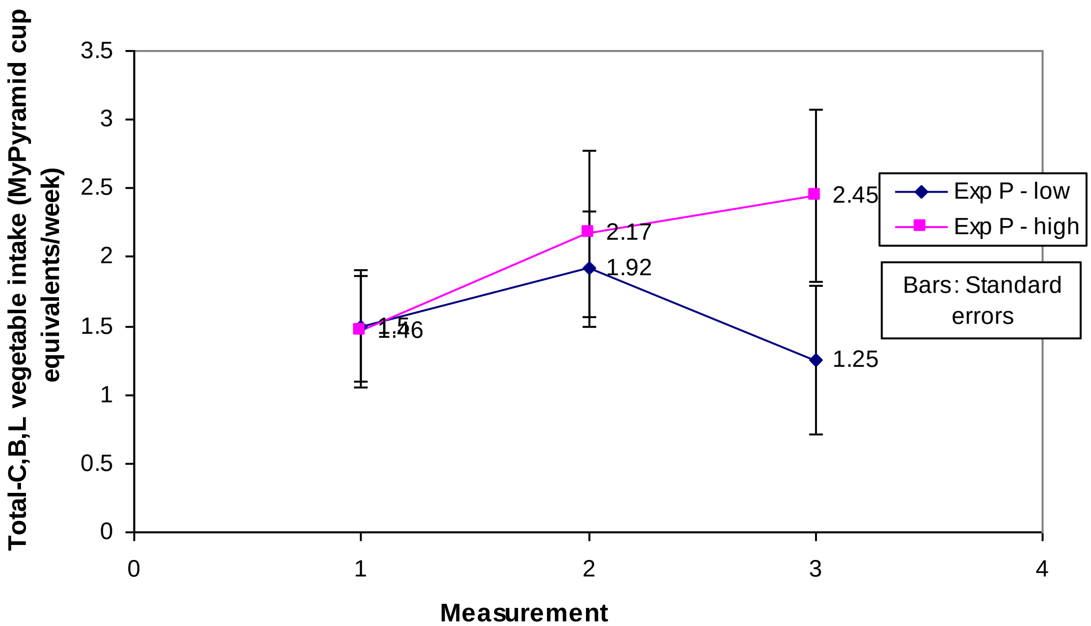
VIA derived total-C,B,L vegetable intake for experimental food preparers by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=10 low and n=15 high; Measurement 2 (Post-test): n=8 low and n=15 high; Measurement 3 (Follow-up): n=7 low and n=15 high
Significant difference between groups at an assessment point: * ($p<0.05$); ** ($p<0.01$); *** ($p<0.001$)

Appendix K

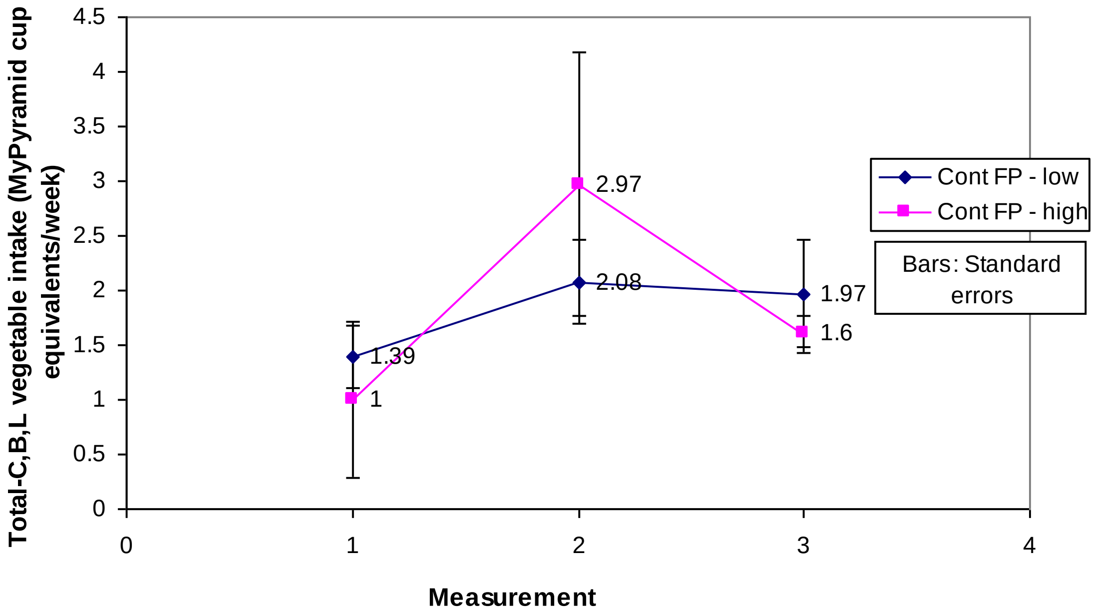
VIA derived total-C,B,L vegetable intake for experimental partners by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=10 low and n=15 high; Measurement 2 (Post-test): n=8 low and n=15 high; Measurement 3 (Follow-up): n=7 low and n=15 high

Appendix L

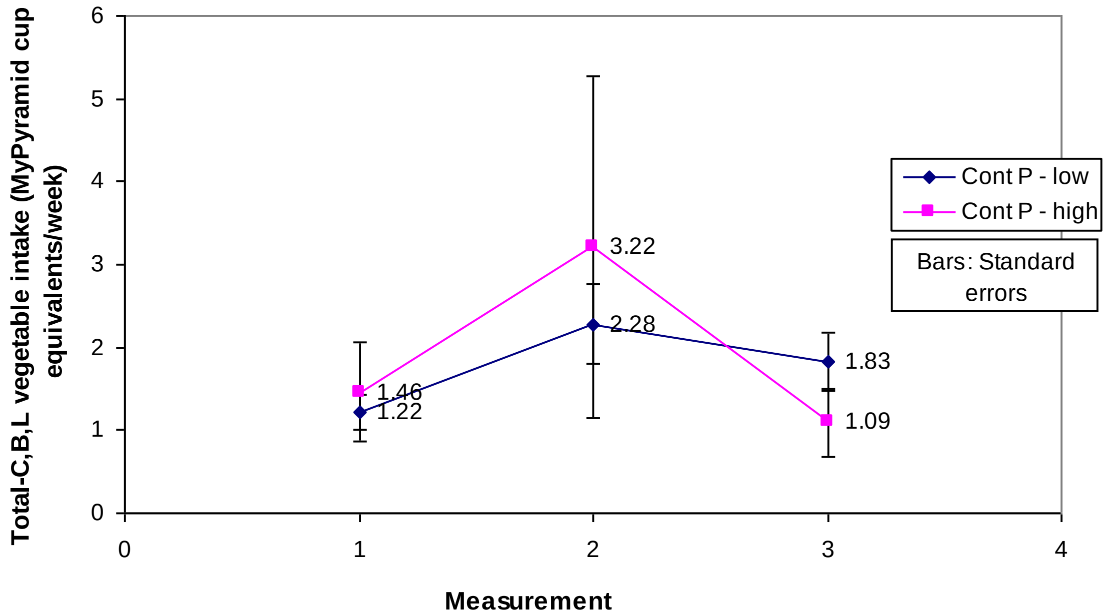
VIA derived total-C,B,L vegetable intake for control food preparers by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=22 low and n=3 high; Measurement 2 (Post-test): n=19 low and n=3 high; Measurement 3 (Follow-up): n=20 low and n=3 high

Appendix M

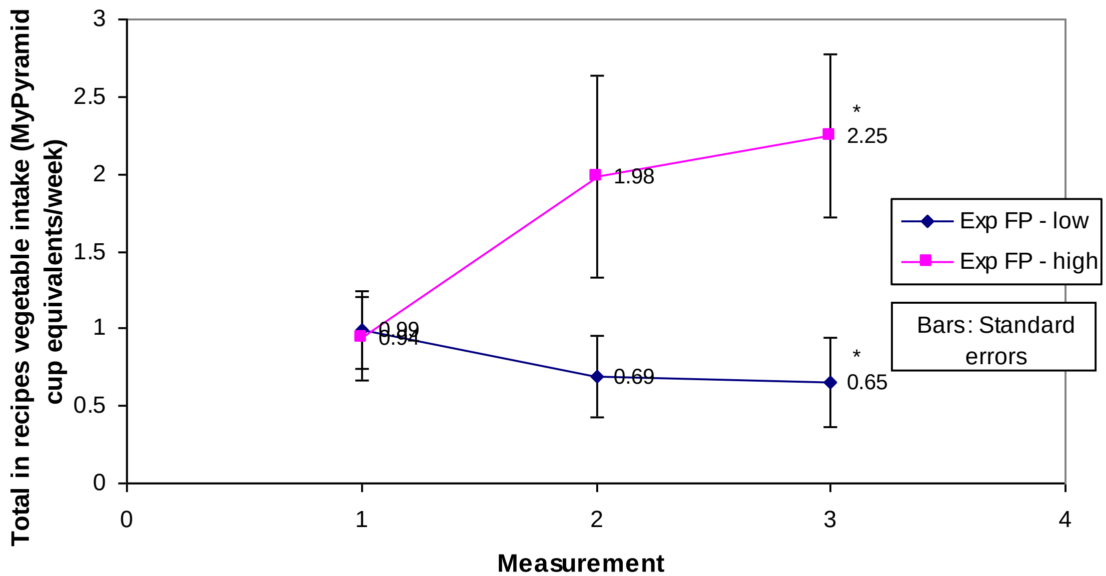
VIA derived total-C,B,L vegetable intake for control partners by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=22 low and n=3 high; Measurement 2 (Post-test): n=18 low and n=3 high; Measurement 3 (Follow-up): n=19 low and n=3 high

Appendix N

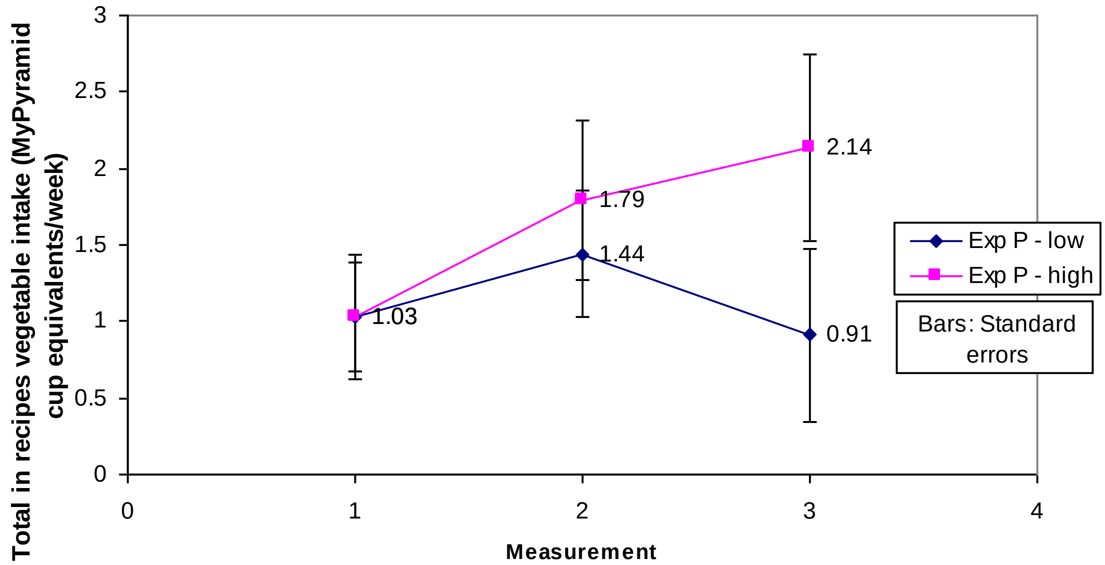
VIA derived total in recipes vegetable intake for experimental food preparers by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=10 low and n=15 high; Measurement 2 (Post-test): n=8 low and n=15 high; Measurement 3 (Follow-up): n=7 low and n=15 high
Significant difference between groups at an assessment point: * (p<0.05); ** (p<0.01); *** (p<0.001)

Appendix O

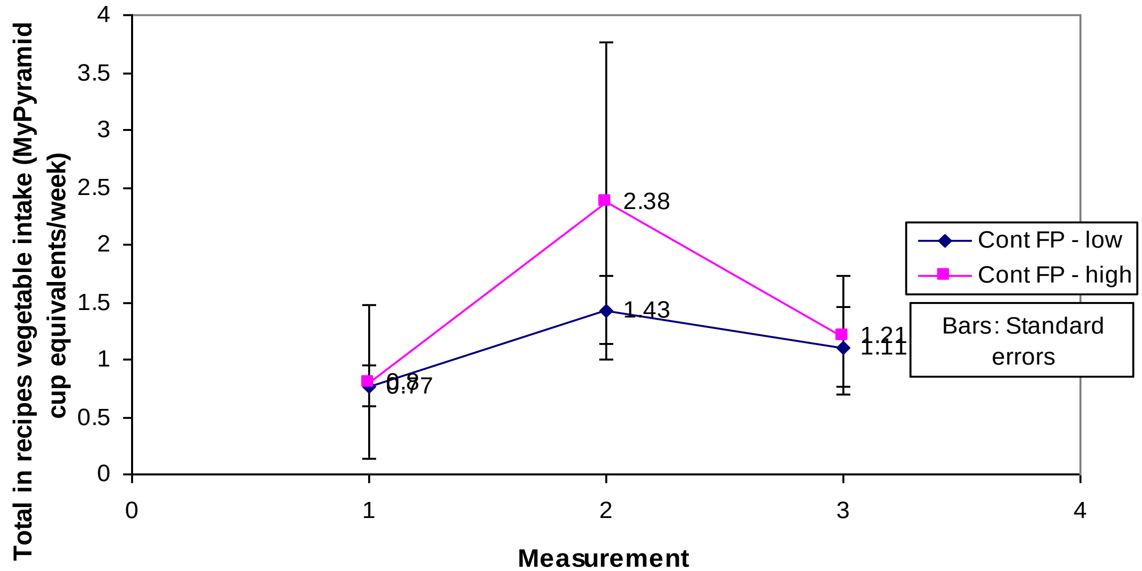
VIA derived total in recipes vegetable intake for experimental partners by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=10 low and n=15 high; Measurement 2 (Post-test): n=8 low and n=15 high; Measurement 3 (Follow-up): n=7 low and n=15 high

Appendix P

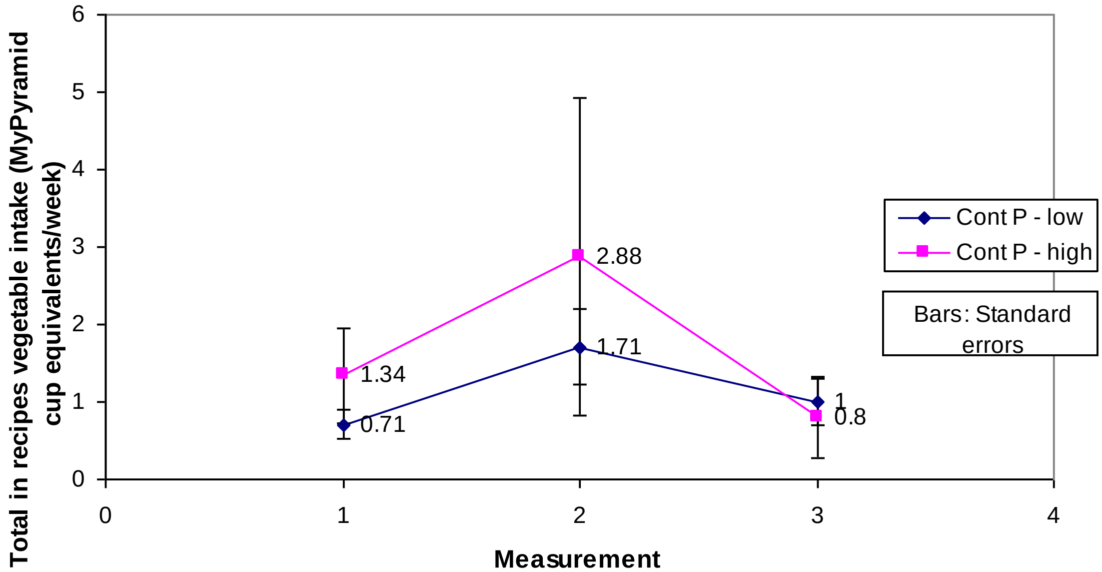
VIA derived total in recipes vegetable intake for control food preparers by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=22 low and n=3 high; Measurement 2 (Post-test): n=19 low and n=3 high; Measurement 3 (Follow-up): n=20 low and n=3 high

Appendix Q

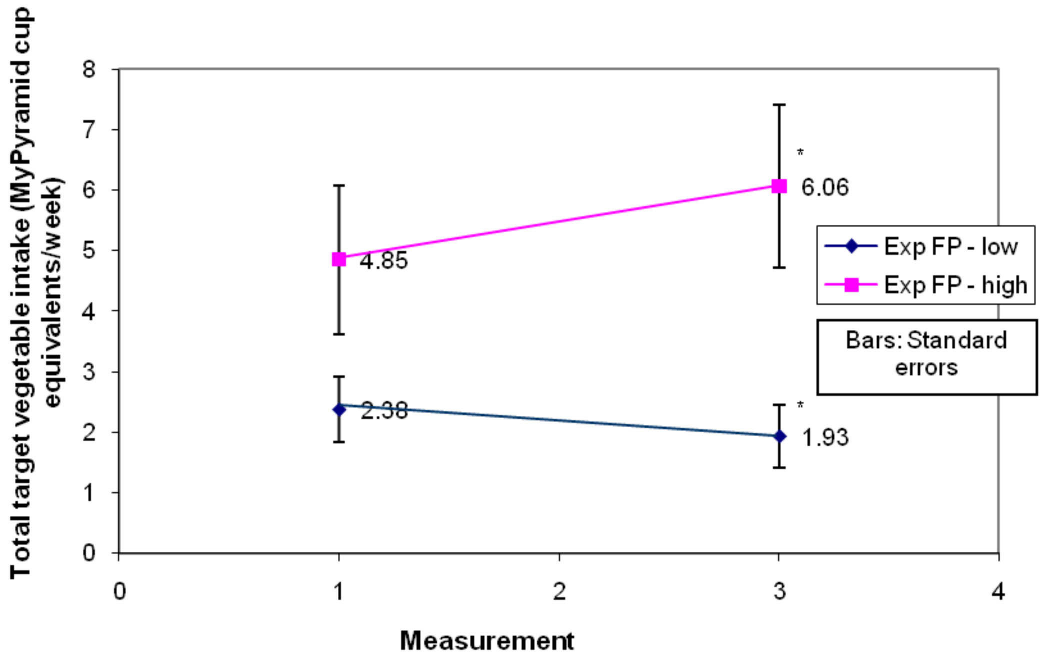
VIA derived total in recipes vegetable intake for control partners by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=22 low and n=3 high; Measurement 2 (Post-test): n=18 low and n=3 high; Measurement 3 (Follow-up): n=19 low and n=3 high

Appendix R

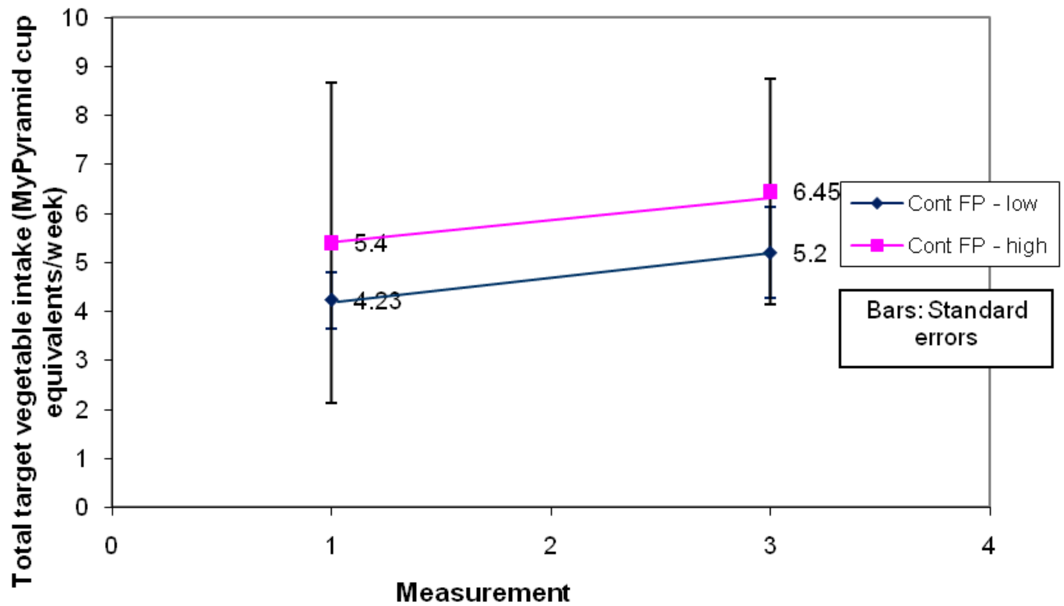
DHQ derived total target vegetable intake for experimental food preparers by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=10 low and n=15 high; Measurement 2 (Post-test): n=8 low and n=15 high; Measurement 3 (Follow-up): n=7 low and n=15 high
Significant difference between groups at an assessment point: * (p<0.05); ** (p<0.01); *** (p<0.001)

Appendix S

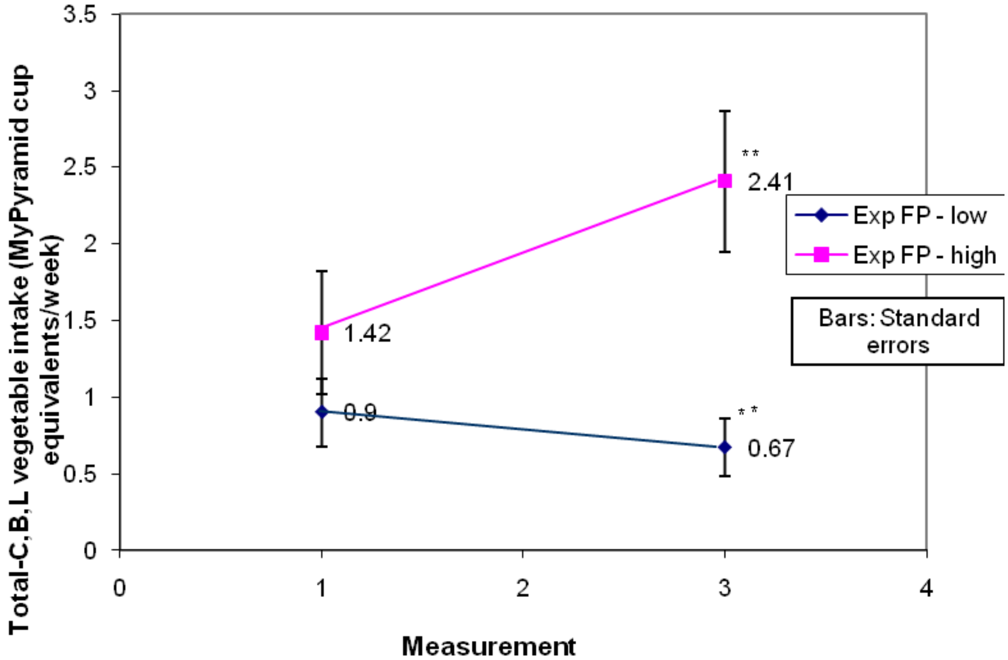
DHQ derived total target vegetable intake for control food preparers by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=22 low and n=3 high; Measurement 2 (Post-test): n=19 low and n=3 high; Measurement 3 (Follow-up): n=20 low and n=3 high

Appendix T

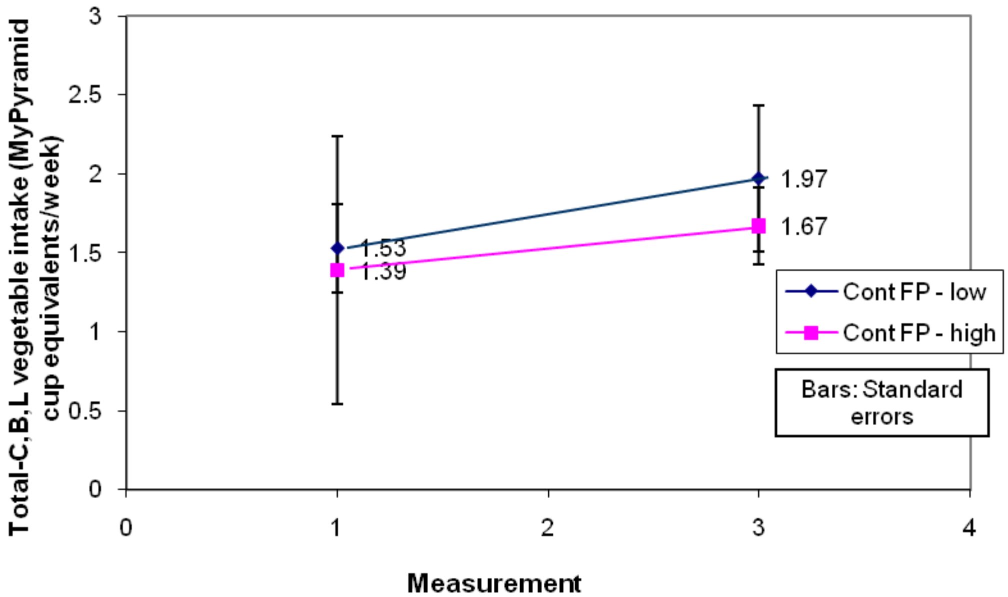
DHQ derived total-C,B,L vegetable intake for experimental food preparers by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=10 low and n=15 high; Measurement 2 (Post-test): n=8 low and n=15 high; Measurement 3 (Follow-up): n=7 low and n=15 high
Significant difference between groups at an assessment point: * (p<0.05); ** (p<0.01); *** (p<0.001)

Appendix U

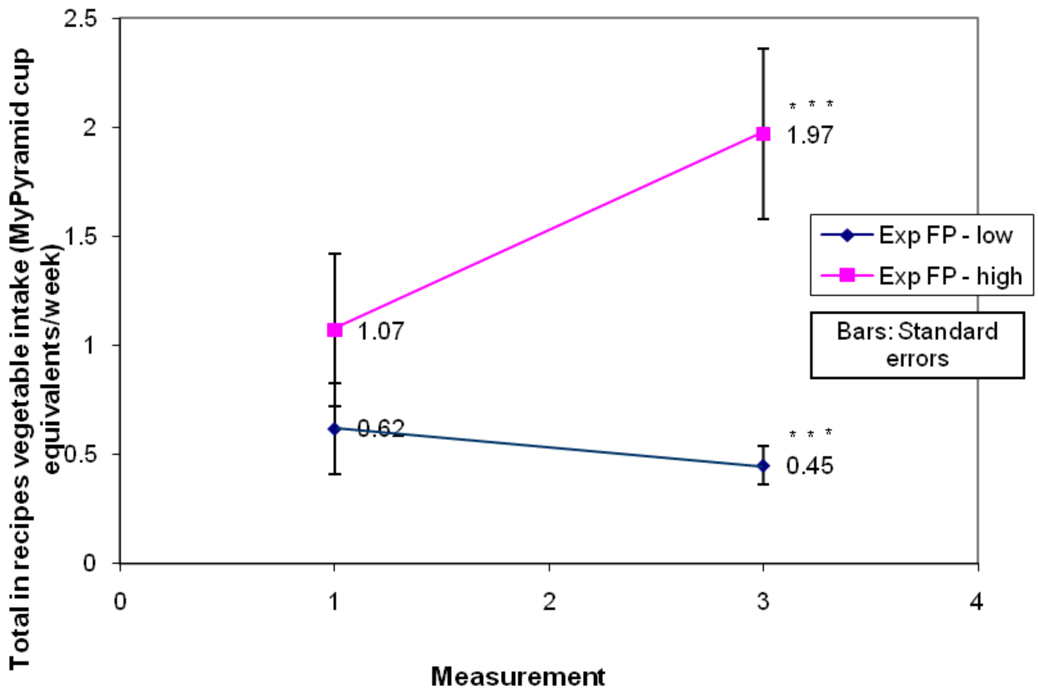
DHQ derived total-C,B,L vegetable intake for control food preparers by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=22 low and n=3 high; Measurement 2 (Post-test): n=19 low and n=3 high; Measurement 3 (Follow-up): n=20 low and n=3 high

Appendix V

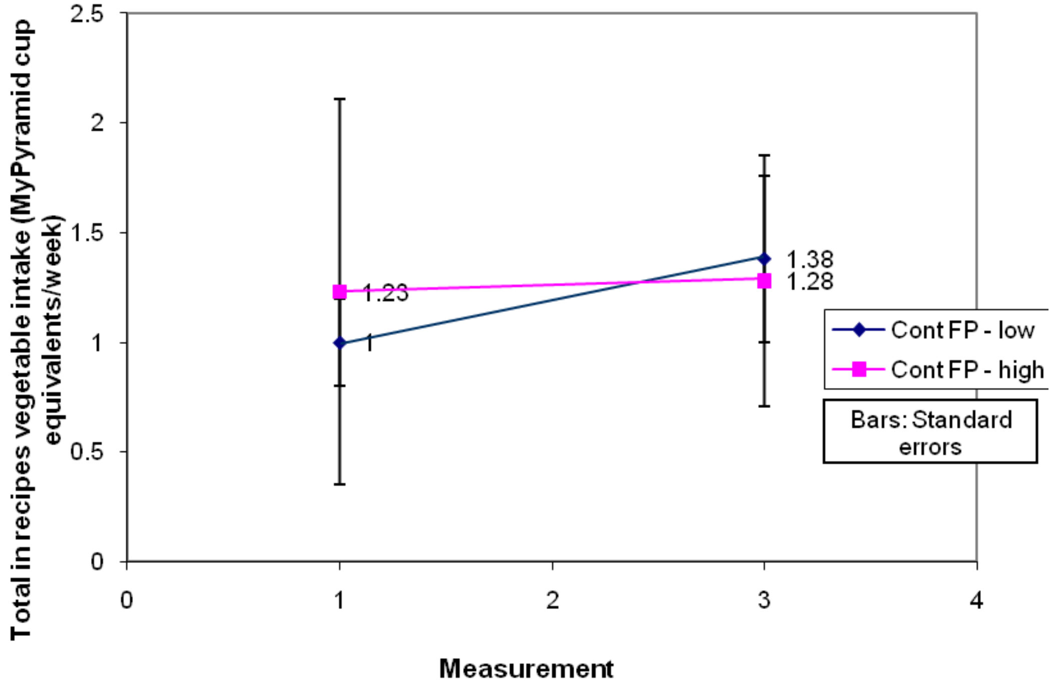
DHQ derived total in recipes vegetable intake for experimental food preparers by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=10 low and n=15 high; Measurement 2 (Post-test): n=8 low and n=15 high; Measurement 3 (Follow-up): n=7 low and n=15 high
Significant difference between groups at an assessment point: * (p<0.05); ** (p<0.01); *** (p<0.001)

Appendix W

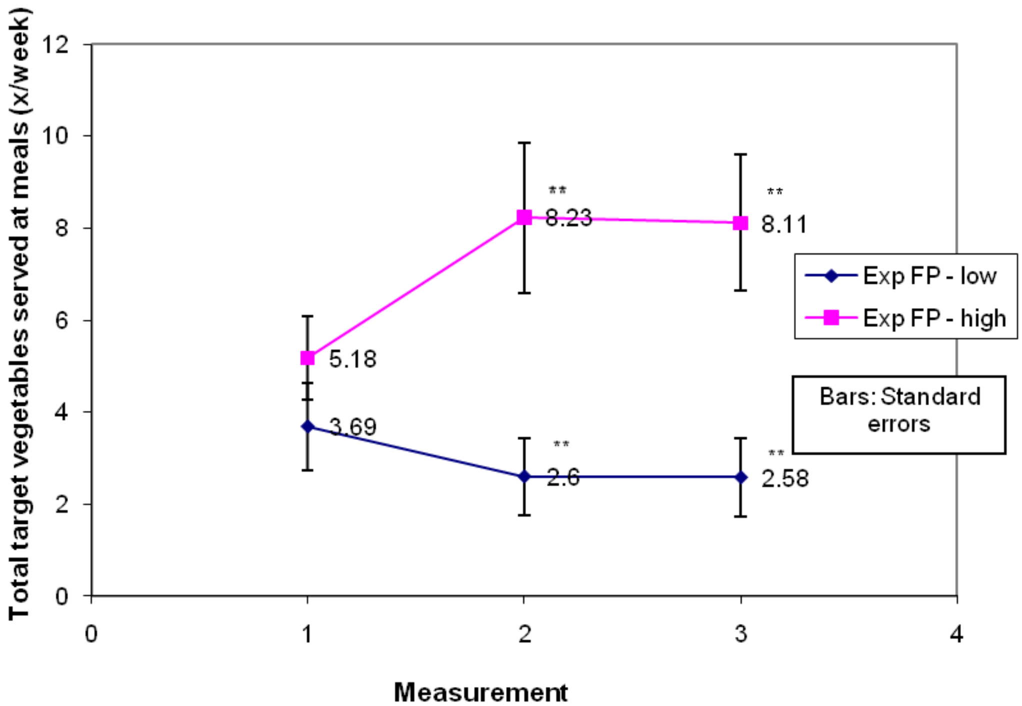
DHQ derived total in recipes vegetable intake for control food preparers by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=22 low and n=3 high; Measurement 2 (Post-test): n=19 low and n=3 high; Measurement 3 (Follow-up): n=20 low and n=3 high

Appendix X

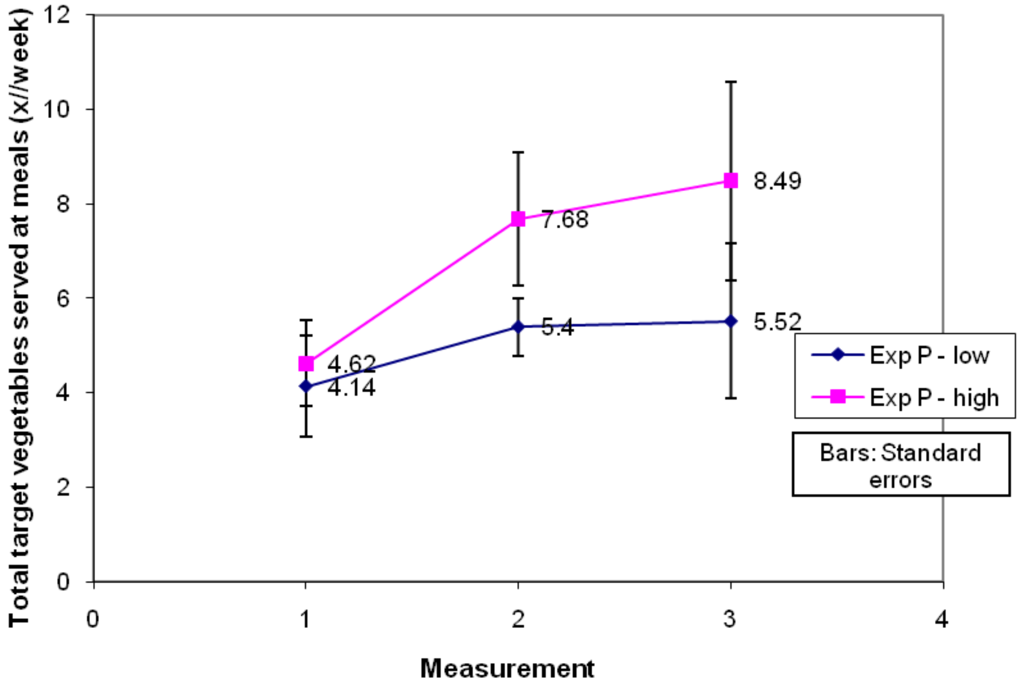
Total target vegetables served at meals for experimental food preparers by low/high meal diary score[1,2]



[1] Low score=meal diary score 0 to 6; high score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=10 low and n=15 high; Measurement 2 (Post-test): n=8 low and n=15 high; Measurement 3 (Follow-up): n=7 low and n=15 high
Significant difference between groups at an assessment point: * (p<0.05); ** (p<0.01); *** (p<0.001)

Appendix Y

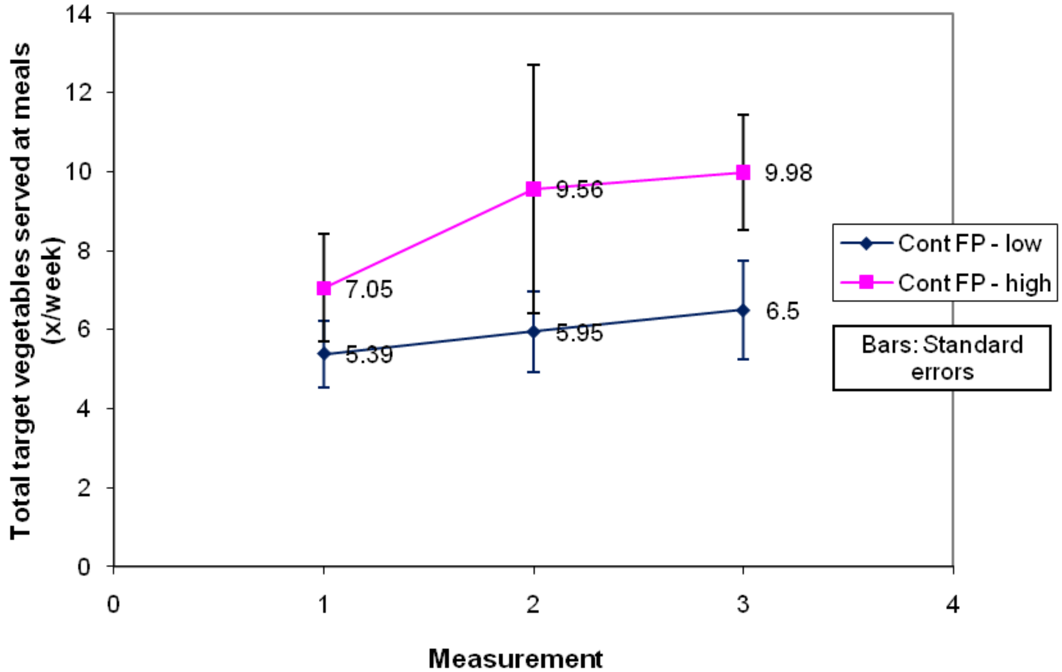
Total target vegetables served at meals for experimental partners by low/high meal diary score[1,2]



[1] Low score=meal diary score 0 to 6; high score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=10 low and n=15 high; Measurement 2 (Post-test): n=8 low and n=15 high; Measurement 3 (Follow-up): n=7 low and n=15 high

Appendix Z

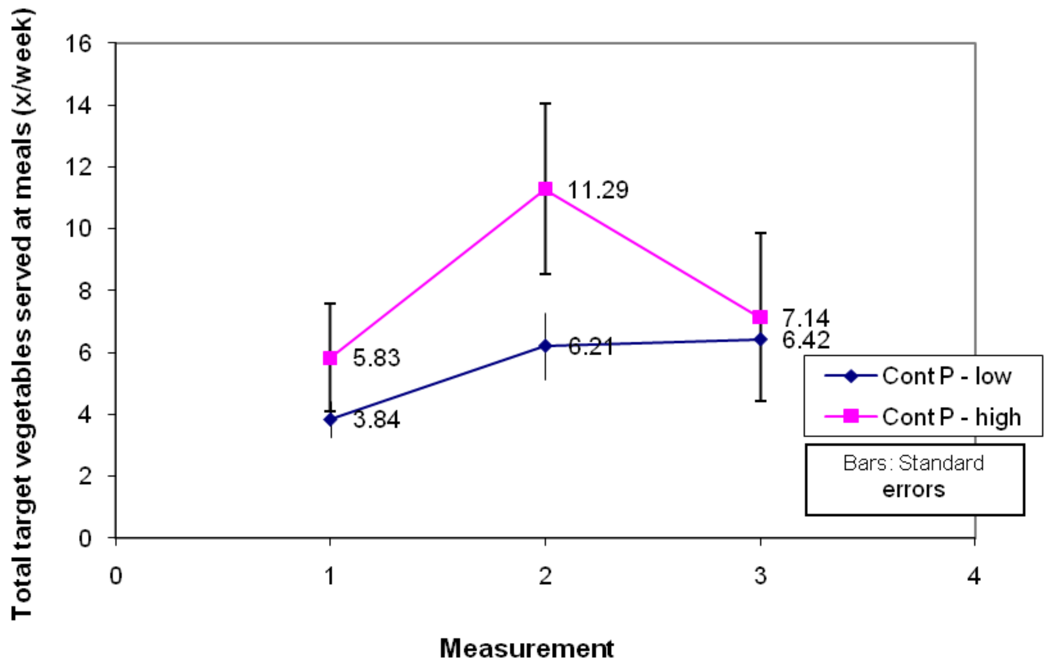
Total target vegetables served at meals for control food preparers by low/high meal diary score[1,2]



[1] Low score=meal diary score 0 to 6; high score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=22 low and n=3 high; Measurement 2 (Post-test): n=19 low and n=3 high; Measurement 3 (Follow-up): n=20 low and n=3 high

Appendix AA

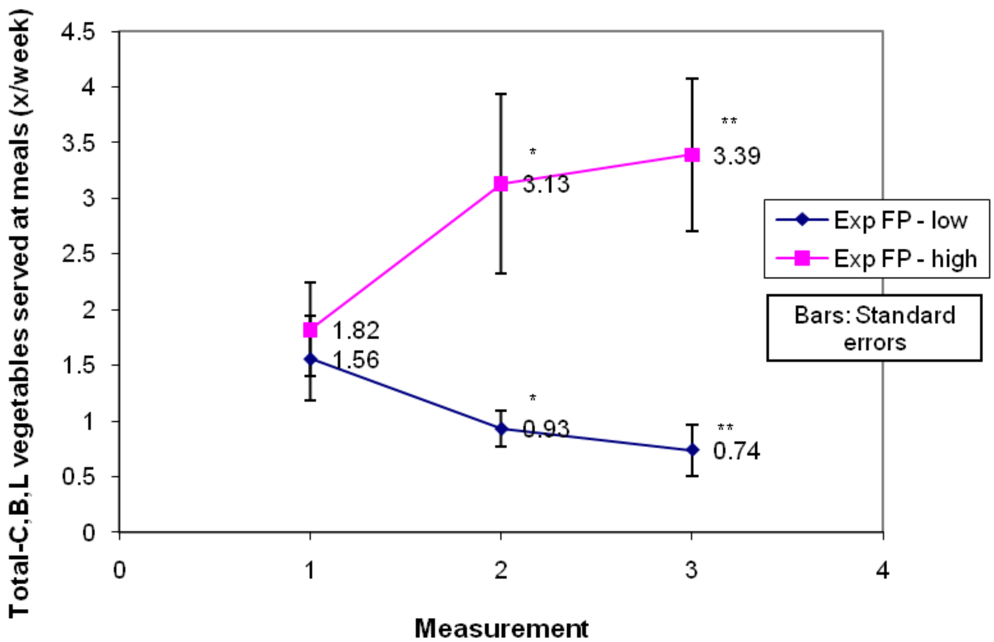
Total target vegetables served at meals for control partners by low/high meal diary score[1,2]



[1] Low score=meal diary score 0 to 6; high score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=22 low and n=3 high; Measurement 2 (Post-test): n=18 low and n=3 high; Measurement 3 (Follow-up): n=19 low and n=3 high

Appendix BB

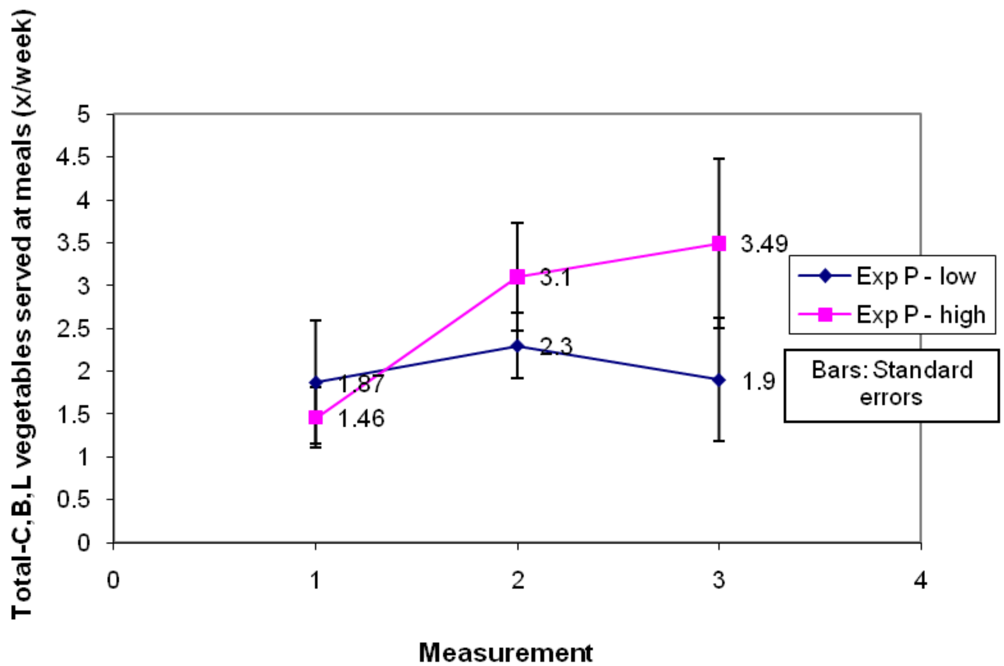
Total-C,B,L vegetables served at meals for experimental food preparers by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=10 low and n=15 high; Measurement 2 (Post-test): n=8 low and n=15 high; Measurement 3 (Follow-up): n=7 low and n=15 high
Significant difference between groups at an assessment point: * (p<0.05); ** (p<0.01); *** (p<0.001)

Appendix CC

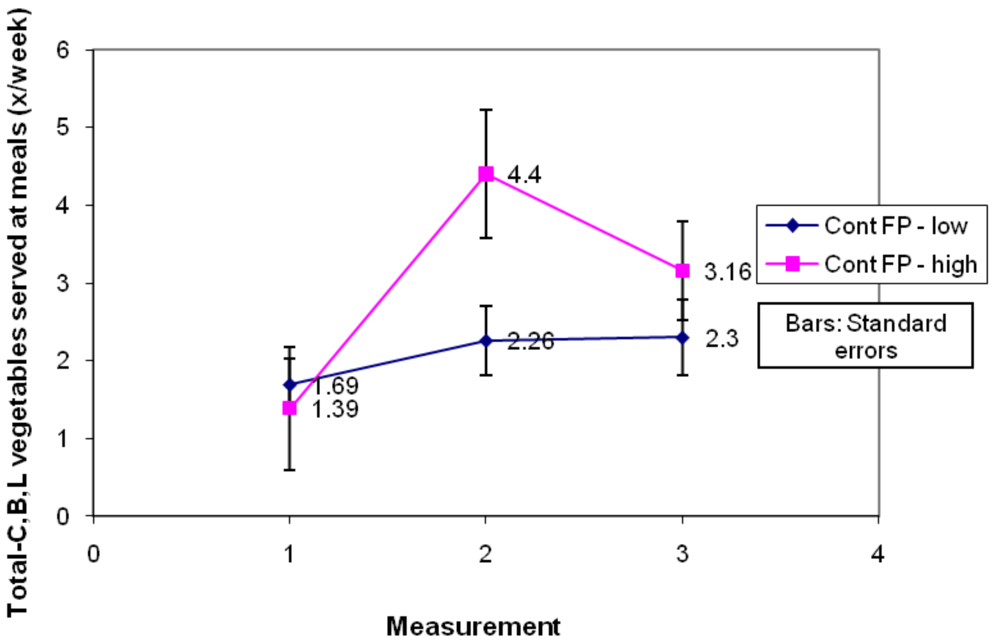
Total-C,B,L vegetables served at meals for experimental partners by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=10 low and n=15 high; Measurement 2 (Post-test): n=8 low and n=15 high; Measurement 3 (Follow-up): n=7 low and n=15 high

Appendix DD

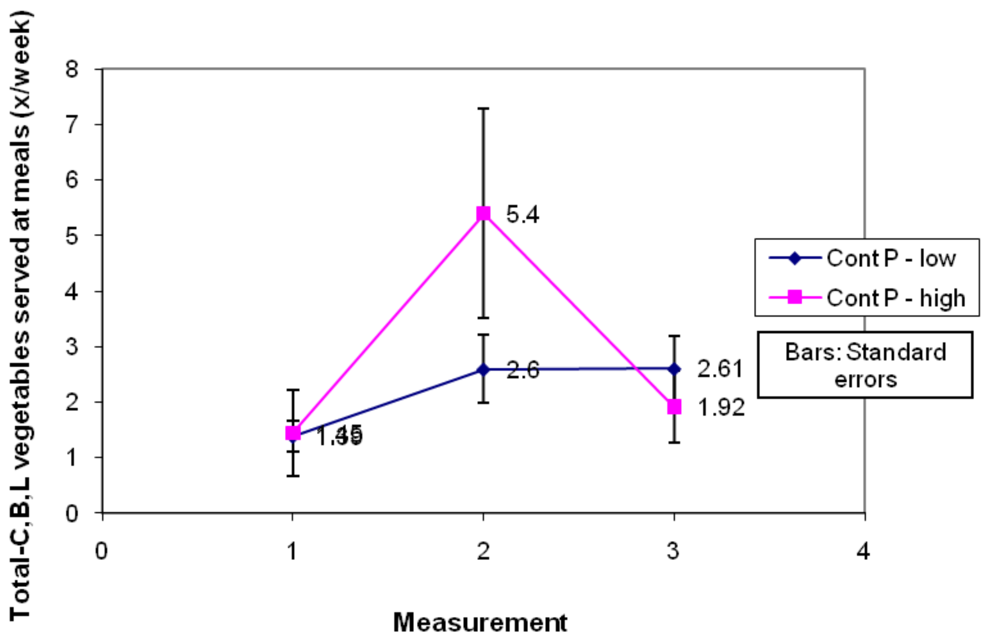
Total-C,B,L vegetables served at meals for control food preparers by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=22 low and n=3 high; Measurement 2 (Post-test): n=19 low and n=3 high; Measurement 3 (Follow-up): n=20 low and n=3 high

Appendix EE

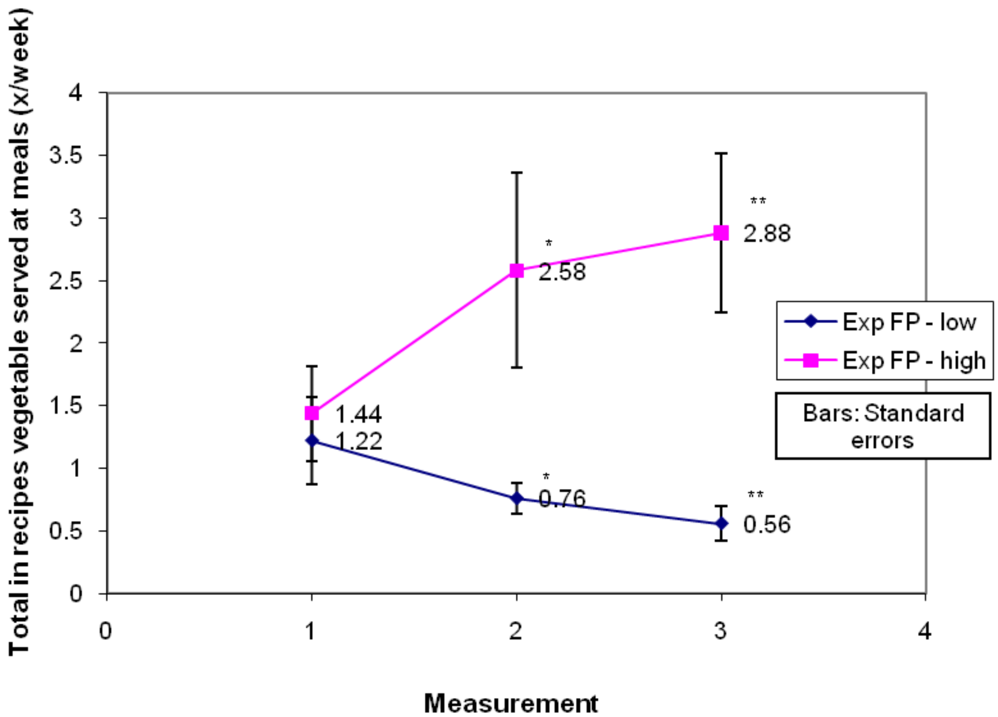
Total-C,B,L vegetables served at meals for control partners by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=22 low and n=3 high; Measurement 2 (Post-test): n=18 low and n=3 high; Measurement 3 (Follow-up): n=19 low and n=3 high

Appendix FF

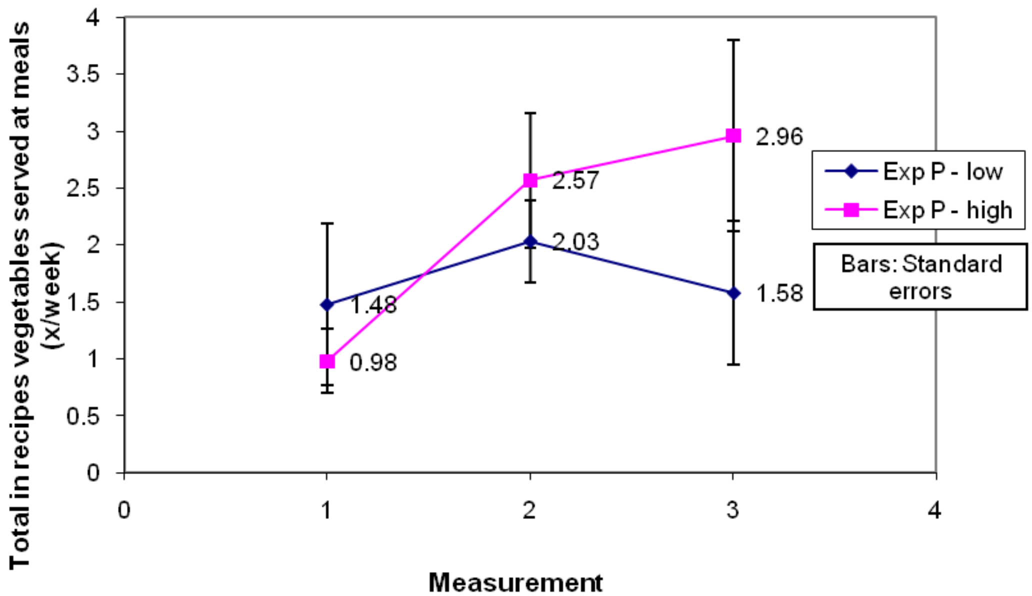
Total in recipes vegetables served at meals for experimental food preparers by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=10 low and n=15 high; Measurement 2 (Post-test): n=8 low and n=15 high; Measurement 3 (Follow-up): n=7 low and n=15 high
Significant difference between groups at an assessment point: * (p<0.05); ** (p<0.01); *** (p<0.001)

Appendix GG

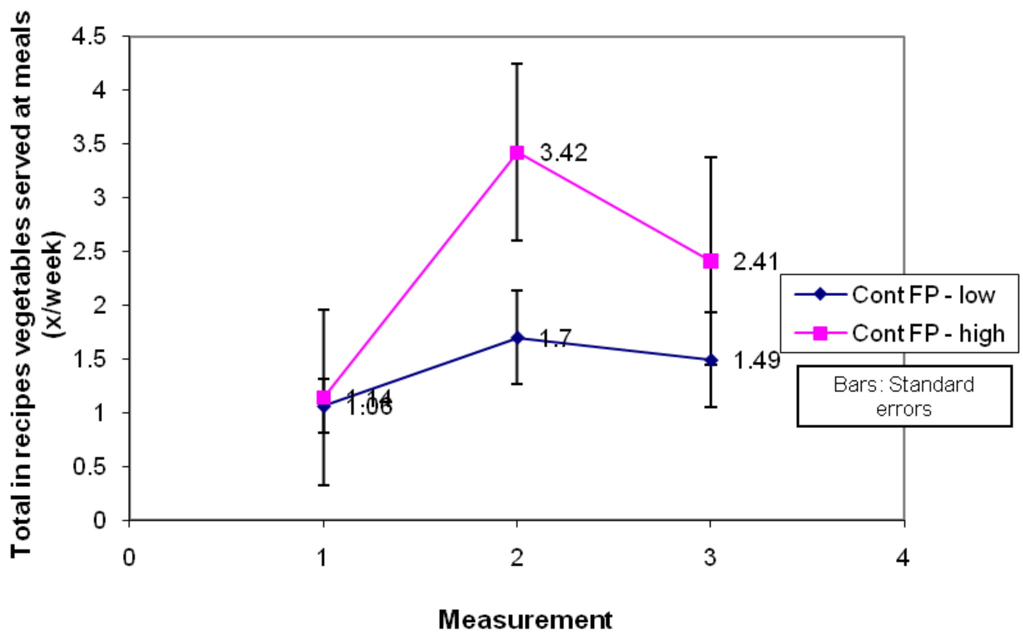
Total in recipes vegetables served at meals for experimental partners by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=10 low and n=15 high; Measurement 2 (Post-test): n=8 low and n=15 high; Measurement 3 (Follow-up): n=7 low and n=15 high

Appendix HH

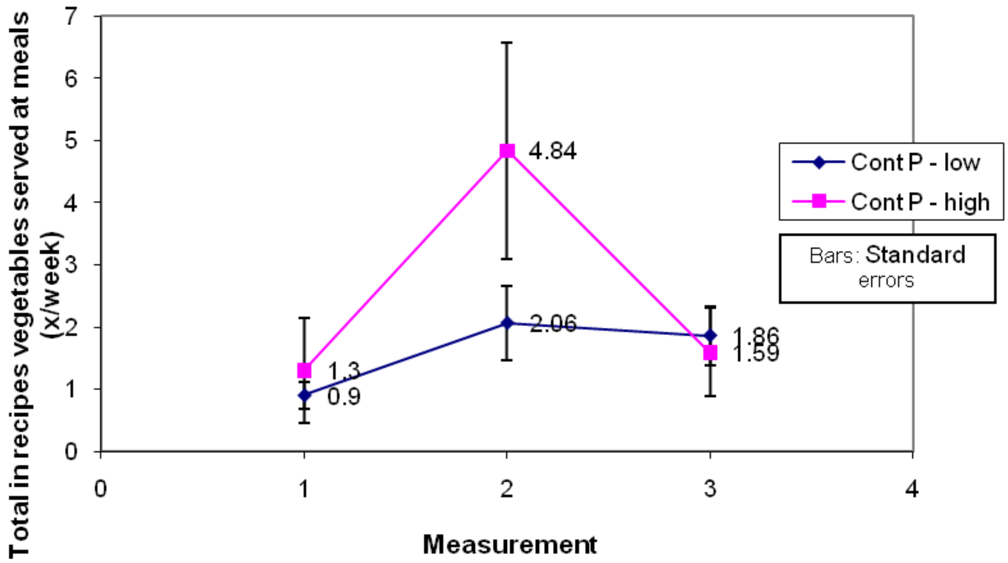
Total in recipes vegetables served at meals for control food preparers by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=22 low and n=3 high; Measurement 2 (Post-test): n=19 low and n=3 high; Measurement 3 (Follow-up): n=20 low and n=3 high

Appendix II

Total in recipes vegetables served at meals for control partners by low/high meal diary score[1,2]



[1] Low-score=meal diary score 0 to 6; high-score=meal diary score 7-15
[2] Measurement 1 (Baseline): n=22 low and n=3 high; Measurement 2 (Post-test): n=18 low and n=3 high; Measurement 3 (Follow-up): n=19 low and n=3 high

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Ph.D. Food Science, The Pennsylvania State University	2010
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PUBLICATIONS

Wenrich TR, Brown JL. Family members' influence on family meal vegetable choices. Journal of Nutrition Education and Behavior. In press.

Wenrich TR, Brown JL. Assessing educational materials using cognitive interviews can improve and support lesson design**.** Journal of Extension [On-line]. 2007;45(3). Available at: http://www.joe.org/joe/2007june/tt4.shtml.

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Cason KL, Cox RH, Burney JL, Poole K, Wenrich TR. Do food stamps without education improve the nutrient intake of recipients? Topics in Clinical Nutrition. 2002;17(4):74-82.

Cason KL, Wenrich TR. Health and nutrition beliefs, attitudes and practices of undergraduate college students: A needs assessment. Topics in Clinical Nutrition. 2002;17(3):52-70.

HONORS AND AWARDS

Mars Incorporated Graduate Scholarship in Food Science – 2008-2009
Robert and Jeanne L. McCarthy Memorial Graduate Scholarship – 2008-2009
The Fred and Florence Jacobson Food Science, Graduate Scholarship – 2006-2007
Janet G. and Frank J. Dudek Graduate Scholarship in Food Science – 2005-2006
William Rosskam Memorial Scholarship – 2004-2005, 2002-2003, 2001-2002
Josephson & Patton Mentorship – 2007-2008, 2003-2004
Evans Family Lecture Certificate of Appreciation - 2004
Golden Key International Honor Society Curtis Miller Scholarship – 2002-2003
Golden Key International Honor Society Certificate of Honor – 2002

PROFESSIONAL AFFILIATIONS

Institute of Food Technologists (IFT) – 1996-Present
Society for Nutrition Education (SNE) – 2003-Present
American Dietetic Association (ADA) – 2003-2009