AGENTS OF CHANGE INTERVENTIONS TO IMPROVE DIETS

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ABSTRACT

Effective and scalable healthy eating interventions are needed that can help people of all ages, race/ethnicities, income levels, and health status consume more healthy foods.[1] The challenge for researchers is to identify interventions capable of nudging entire populations to eat healthier foods to improve health and quality of life.[2] "Agent of change" is a general term used to describe a person acting within an intervention to ultimately bring about change in another individual. The objectives of this dissertation were to create and evaluate two agents of change interventions designed to improve dietary intake.

For the first intervention, twenty-one Michigan State University Extension Community Nutrition Instructors were trained to coach Michigan school child nutrition professionals (agents of change) to make changes to their school cafeterias designed to increase children's selection of fruits and vegetables. Sixty-seven school nutrition professionals completed a checklist of cafeteria practices before and after making cafeteria changes. Thirty schools submitted five days of pre- and post- food production records. Mean values of Scorecard totals and five-day average cups of fruits and vegetables selected per student as measured by schools' production records were calculated for pre- and post-cafeteria changes. Changes were assessed using t-tests. A regression analysis was conducted to determine if schools demonstrating greater improvement in their overall Scorecard also demonstrated increased selection of cups of fruits and vegetables per student. After coaching by the MSU Extension Community Nutrition Instructors, there were significant increases in the number of school cafeteria changes made, regardless of school grade, percentage of students participating in the school meal program, and whether the school formed a student team. There were no statistically significant improvements in the cups of fruits or vegetables selected by students after the cafeteria changes, and selection of fruits and vegetables was not associated with cafeteria improvements.

For the second intervention, two cohorts of college students enrolled in similar asynchronous 14-week online introductory nutrition courses, one with and one without six agents of change assignments, were administered validated surveys to evaluate pre- and post-course dietary intake and nutrition knowledge. The agent of change assignments were designed for students to encourage their family and friends to increase intake of whole plant foods. Students were required to create six video presentations and encouraged but not required to share their videos with family members and/or friends. Regression analyses were conducted to determine

associations between gender, perceived cost, taste, ease of eating, and dietary and nutrition knowledge before taking the course among students enrolled in the course with the agent of change assignments. College student mean intakes of whole grains, fiber, fruits and vegetables, and dairy did not meet U.S. recommended dietary guidelines daily intake levels and students consumed more added sugars and added sugars from sweetened beverages than recommendations. Perceived ease of eating healthy foods, perceived cost of healthy foods, and nutrition knowledge were all significantly associated with consumption of combined fruits and vegetables, vegetables, fruit, and dietary fiber. Students in both cohorts significantly increased their nutrition knowledge and decreased total added sugar intake over the course of the semester. Students in the cohort without the agent of change assignments also significantly increased their intakes of whole grain, fiber, and vegetables.

Perceived changes in dietary-related knowledge, skills, and consumption of healthier foods were measured post course completion for the cohort with the agent of change assignments. Students in this cohort were divided into two groups: students who acted as agents of change (created and shared healthy eating videos with their friends and family members), and students who did not act as agents of change (created videos but did not share them). The agent of change group did not exhibit any significant differences in mean change in nutrition knowledge and dietary intake compared to students who did not act as agents of change. However, students who acted as agents of change demonstrated significantly greater perceived increases in nutrition knowledge and familiarity with, skills to eat and prepare, confidence, motivation, and consumption of healthy foods as compared to students who did not act as agents of change.

Overall, this dissertation research adds to the healthy eating intervention literature by evaluating interventions using novel agent of change approaches in public school and university settings. It also demonstrates: 1) how public health organizations, public schools and nutrition interventionists might leverage partnerships with schools and universities to explore ways to use agents of change to reach large populations; 2) demonstrates the need for continued investigation into intervention elements required to change eating behaviors; and 3) highlights the need for further research to better understand and describe drivers of selection and consumption of healthier foods.

ACKNOWLEDGEMENTS

"At times, our own light goes out and is rekindled by a spark from another person. Each of us has a cause to think with deep gratitude of those who have lighted the flame within us"
– Albert Schweitzer

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CHAPTER 1 - INTRODUCTION

Background

Diet-related chronic diseases are common among adults. The most recent Dietary Guidelines for Americans recommended that prevention efforts take place across all life stages, genders, and racial and ethnic groups in people with and without chronic diseases.[1] Moreover, the World Health Organization estimates the risk of chronic diseases could be reduced by 80% if smoking, physical inactivity, and poor diets were eliminated.[3] However improving individual dietary behaviors is challenging and many interventions designed to improve lifesyle behaviors through individual education and encouragement have shown little success.[4] As stated by the Institute of Medicine, "The main challenge no longer is to determine what eating patterns to recommend to the public …[it is] how to inform and encourage an entire population to eat so as to improve its chance for a healthier life."[2] Thus, innovative dietary interventions designed to shift eating patterns to include more vegetables, fruit, whole grains, and legumes are needed and important to prevent and reduce chronic disease, mortality, and morbidity.

My long-term goal is to investigate and identify effective and scalable healthy eating interventions that can help people of all ages, income levels, chronic disease status, races and ethnicities consume more healthy foods. The objectives for this dissertation were to evaluate two agent of change nutrition interventions designed to improve dietary outcomes among school aged youth (5-18 years of age) and young adults (18-25 years of age). "Agent of change" is a general term used to describe a person acting within an intervention to ultimately bring about change in another individual. The first intervention recruited school nutrition professionals as agents of change to effect dietary change in school aged youth by improving their school cafeteria environments. Specifically, Michigan State University (MSU) Extension professionals trained school nutrition professionals as agents of change to use behavioral economic strategies to increase selection of fruits and vegetables among school-aged youth (5-18 years of age) within public schools. The second intervention recruited college students to act as agents of change for their family and/or friends. University students (18-25 years of age enrolled in an introductory nutrition course) developed personalized nutrition education videos and distributed them to their family and friends to encourage increased intakes of whole plants foods: fruits,

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vegetables, whole grains, legumes, and raw nuts and seeds. Both interventions focused on increasing selection and/or consumption of food groups under consumed in the U.S.

Specific Aims

<u>*Smarter Lunchroom Scorecard Intervention Specific Aims (1 And 2) and Hypothesis*</u>

Specific Aim 1: Develop a Smarter Lunchroom Scorecard Intervention for Michigan students ages 5-18 years old.

Specific Aim 2: Determine whether completing a Smarter Lunchroom Scorecard Intervention increases: 1) Smarter Lunchroom Scorecard cafeteria scores and 2) cafeteria selection of fruit and vegetables among Michigan students.

Hypothesis: Students in schools showing Smarter Lunchroom Scorecard score increases will increase selection of fruits and vegetables.

<u>*University Student Intervention Specific Aims (3a, 3b, 3c) and Hypotheses*</u>

Specific Aim 3a: Determine if gender, pre-course nutrition knowledge, perceived health benefits of healthy foods, perceived healthy eating support from family and friends, and perceived cost, ease of eating, and taste of healthy foods are associated with pre course diet among college students enrolled in an undergraduate introductory nutrition course.

Hypothesis: Variables listed in aim 3a will be associated with pre course diet.

Specific Aim 3b: Determine if college students enrolled in an introductory human nutrition course with agent of change (AOC) assignments (2021 AOC Cohort) made greater improvements in nutrition knowledge and diet compared to college students in a course without agent of change assignments (2020 no-AOC Cohort).

Hypothesis: Students enrolled in an introductory human nutrition course with agent of change assignments (2021 AOC Cohort) will make greater nutrition knowledge and dietary improvemennts than students in a class without agent of change assignments (2020 no-AOC Cohort).

Specific Aim 3c: Determine if college students enrolled in introductory human nutrition course who acted as agents of change (2021 AOC-shared group) have more perceived improvements in healthy eating knowledge, familiarity, skills, confidence, motivation, and healthy food consumption over the course of the semester compared to students who did not act as agents of change (2021 AOC-no shared group).

Hypothesis: Students who acted as agents of change (2021 AOC-shared Cohort) will report greater improvements in perceived healthy eating knowledge, familiarity, skills, confidence, motivation, and healthy food consumption compared to students who did not act as agents of change (2021 AOC-no shared group).

Significance

Dietary patterns are established early in life and impact long term health status. Identifying interventions that improve dietary patterns at all life stages is important. Intervening with youth and young adults has potential to prevent and/or delay the onset of future diet-related chronic diseases.[1,5] Organizations tasked with implementing prevention programs can benefit from employing innovative ways to expand intervention reach while controlling implementation costs. One approach to accomplish this is to train lay people to deliver or support specific elements of an intervention. For example, community members, health professionals, educators, and students can be trained as peer educators, health navigators, community health workers, and/or student ambassadors. Collectively these trained individuals can be called "agents of change" or "change agents" because they act as a mediator and/or catalyst for behavior change to occur within a target group. They can increase message salience and provide important social support to increase the likelihood that behavior change takes hold in the individuals of interest.

This dissertation research explores intervention approaches that work with agents of change. However, there were no studies found through a literature search performed as part of

this dissertation research that focused on young adults between the ages of 19-24 years acting as agents of change. Moreover, no studies were discovered where students acted as change agents to convey nutrition information to family members/friends or school food service professionals acting as change agents to improve the school cafeteria environment. This dissertation research aimed to address these gaps by investigating agent of change nutrition intervention approaches with young adults and school food service professionals.

In addition to investigating agents of change interventions, this research also addresses gaps in the literature examining: 1) the effects of utilizing behavioral economic strategies within schools, characterizing young adult dietary intakes, and 2) implementing a university course as a dietary intervention with young adults. The research study investigating aims 1 and 2 was a collaboration among Michigan State University Extension, Michigan Team Nutrition, Michigan State University Department of Food Science and Human Nutrition and participating public schools. The study examined the effects of working with Michigan State University Extension professionals to train School Nutrition Professionals (agents of change) to use behavioral economic strategies to increase student selection of fruits and vegetables. Previous research had demonstrated that using behavioral economic strategies such as offering more than one type of fruit or vegetable,[6] slicing/precutting fruit,[7] and improving the visual appearance of vegetables[8] improved fruit and vegetable consumption. However, prior to this study, no previous studies had investigated the effect of using behavioral economic strategies together as listed in the Smarter Lunchroom Scorecard to increase student selection of fruits and vegetables. Findings from this research will be beneficial for school nutrition professionals to learn if the proposed strategies are effective at increasing selection of fruits and vegetables. It will also be beneficial for state extension programs working in schools because this research evaluates a model of implementation where extension professionals train school nutrition professionals to create healthier cafeteria environments. Moreover, state extension programs will benefit by learning possible strategies to encourage healthier food selection among school aged youth.

The research study investigating aims 3a - 3c worked with students in the Michigan State University Department of Food Science and Human Nutrition's Introduction to Nutrition course and studied the effects of an agents of change nutrition intervention aimed at improving dietary patterns with young adults (18-25 years). For this study, young adults enrolled in a university introduction human nutrition course were recruited to act as nutrition agents of

change by sending personalized nutrition videos to their family and friends to encourage healthy eating. Despite approximately 19 million young adults being enrolled in a college or university annually and making up 12% of the adult population in the United States, there are few dietary interventions which have worked within a college level course as an intervention strategy to improve dietary behaviors.[9,10]   Existing research, though limited, supports the idea of exploring the use of a university nutrition course to improve dietary behaviors of young adults.

Although types of nutrition courses and outcome measures varied among the studies, all five studies identified showed some dietary improvements for students after taking a nutrition course. [11-16] This dissertation research sought to build upon existing research by using validated dietary assessment tools, a pre/post study design, and course assignments aimed at improving dietary intakes of healthier foods.

The approaches and results of this research may be used by agencies and organizations seeking to improve dietary behaviors of school aged youth and young adults. Agencies and organizations such as public school systems, state extension and research programs, university health promotion programs, and university food and nutrition departments may benefit from exploring how best to use agents of change to reduce intervention costs, expand programming impact and reach, and increase healthy eating behaviors.

CHAPTER 2 - LITERATURE REVIEW

All Life Stages Benefit from Improved Dietary Behaviors

Diet-related diseases are common. According to the World Health Organization, approximately 70% of diseases globally are preventable chronic diseases such as heart disease, stroke, diabetes, and chronic lung diseases.[17] It is also reported that the chronic disease burden stemming from poor dietary intakes is greater than the disease burden from tobacco, alcohol, and physical activity combined.[18] In the U.S., over 50% of adults live with one or more diet related chronic disease[1] and midlife all-cause mortality rates increased between 2010-2017.[19] This is despite the fact that the U.S. spends over 3.5 trillion annually on health care.[20]

According to Waters et al,[21] 47% of health care costs associated with chronic disease stem from treatment of overweight- and obesity- related diseases with the most common chronic diseases being dyslipidemia, hypertension, osteoarthritis, and diabetes. Increasing age is also an important risk factor to consider in the onset of diet related chronic diseases. For example, the prevalence of chronic diseases rise after age 25 through the mid 80's where they plateau or slightly decline, depending on the disease.[5] In addition, Benjamin et al[22] report that the percent of the U.S. population meeting ideal cardiovascular health metrics (such as smoking, physical activity, total cholesterol, diabetes, body mass index, healthy diet score, blood pressure) decrease after age 20; with females more likely to meet more metrics than males; and African Americans and Hispanics meeting the least number of metrics compared to Caucasian Americans and other races. As a result of the prevalence, cost and premature death caused by chronic diseases, the most recent Dietary Guidelines recommend that prevention efforts take place across all life stages, genders, and racial and ethnic groups in people with and without chronic diseases.[1]

Dietary Changes Prevent Chronic Diseases

Diets high in unprocessed plant foods such as fruits, vegetables, legumes, whole grains, nuts and seeds are associated with chronic disease protections such as reductions in cardiovascular diseases.[23] According to the most recent Dietary Guidelines report, only three dietary patterns are associated with better health outcomes: the Healthy U.S.-Style Dietary Pattern, the Healthy Vegetarian Dietary Pattern, and the Healthy Mediterranean-Style Dietary

Pattern.[1] The common characteristics in these dietary patterns include higher intakes of vegetables, fruits, legumes, whole grains, low or nonfat dairy, lean meats, seafood, and poultry; and lower intakes total added sugars and refined grains.[24] In addition, diets high in total energy, saturated fat, sodium, and added sugars are associated with increased risk of developing chronic diseases.[25] U.S. adults and children, eat too much total energy, saturated fat, sodium, added sugars and not enough unprocessed plant foods such as fruit, vegetables, legumes, whole grains, nuts and seeds.[24] Thus, shifting American eating patterns to include more vegetables, fruit, whole grains, and legumes is an important strategy to reduce chronic disease, mortality, and morbidity.

Among U.S. adults, non-starchy vegetable intake levels are below the daily ≥ 2.5 cups recommended levels across all racial and ethnic subgroups, with only white non-Hispanic females meeting the goal.[22] Fruit consumption is also below the ≥ 2 cups/day of recommended intake levels, with average fruit consumption among adults ranging from 1 to 1.6 servings per day. Moreover, among racial subgroups, few are meeting the daily fruit recommendation (9% of non-Hispanic whites, 7% of non-Hispanic blacks, and 6% Mexican Americans meet the recommendation).[22] Less than 10% of U.S. adults met the whole grain guidelines of consuming 3 or more servings per day and only about 10% of non-Hispanic whites, 5% of non-Hispanic blacks, and 14% of Mexican Americans met the daily recommended levels of ≥ 28 grams of dietary fiber.[22] An evaluation by Perera et al reported that mature legume and dry bean consumption frequency decreased between 2011 and 2014, 12.8% to 8.3% and 10.0% to 6.5% respectively.[26] Lastly, only 25% of whites, 16% non-Hispanic blacks, and 12.5% Mexican Americans met the average weekly intake recommendation of 4 or more servings of nuts and seeds per week.[22]

Like adults in the United States, youth do not meet federal dietary guidelines.[27] Children between 4 and 18 years of age do not consume adequate amounts of dark green leafy vegetables, beans, fruit, and whole grains.[27] For example, approximately 50% of children 4-8 years of age do not meet recommended fruit intake levels.[24] In fact, fruit intake levels off for children 5-11 years of age and remains below recommended levels into adulthood.[24] For vegetable intake, between 88 and 99 percent of adolescents do not meet the recommended intake levels.[24] Less than 2% of adolescents between the ages of 14 and 18 meet the recommended vegetable intake levels.[24] In addition, among 12-19 year olds, there was a

reported decline in vegetable intake observed between the 2003-2004 and 2015-2016 National Health and Nutrition Examination Surveys.[24]

Using Behavioral Economic Strategies to Increase Intakes of Healthy Foods Among Youth

The first intervention study described in this dissertation investigated the use of school nutrition professionals acting as agents of change within schools with youth between the ages of 5-18 years of age. Interventions with youth are important because dietary preferences and habits start early.[28] Working with schools on nutrition interventions is one avenue for reaching youth .[29] Over 50.7 million students between the ages of 5-18 years of age attend public schools.[9] Low-cost, easy-to-implement strategies, such as those from the field of behavioral economics show promise when intervening with school aged youth.[30] Behavioral economics is a field of study which uses approaches from psychology and economics to influence human behavior,[31] Behavioral economic strategies can nudge students to select and consume more nutrient dense foods. Examples include placing a healthier item first on the serving line, placing fruit at multiple points on the service line, serving raw cut vegetables with dip, and slicing or cutting whole fruit.[31]

Recent systematic reviews have summarized behavioral economic approaches within the school setting. In one such review, Marcono et al[32] searched five databases and identified and evaluated 25 studies that investigated a variety of behavioral economic strategies. The most reported strategies were changing the order of food placement in a cafeteria line, making it more convenient to select certain foods, ensuring food served is attractive, increasing variety of healthier foods, and using food labels. Seventeen out of the 25 studies reviewed showed positive outcomes on student selection of healthy foods and 11 studies showed positive changes related to consumption of healthy foods.[32] Another systematic review of school meal interventions using behavioral economic strategies conducted by Metcalfe et al performed a Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) process to evaluate twenty-nine studies. The studies were grouped into three intervention approaches: placement/convenience, marketing/promotion, and variety/portions. Seven of the eight studies investigating placement/convenience approaches reported positive associations for vegetable, fruit, milk and water with selection. Four of the eight studies had positive outcomes for vegetable consumption. Of the three studies using marketing and promotion interventions, such

as encouraging selection through verbal prompts, positive outcomes were reported for selection of vegetables, fruits, and entrees and one study reported positive outcome for fruit consumption. Regarding the two studies that were grouped in studies using variety and portion interventions, one study reported positive outcome from fruit consumption.[33]

In a third systematic review of behavioral economic strategies in schools, Mumby et al[34] reported that seven of 11 studies reviewed demonstrated increases in selection of fruits, vegetables, whole grains, and milk comparing pre versus post results or comparing to a control group. However, changes in consumption of these foods were inconsistent across studies, with consumption being associated with behavioral economic strategies involving children naming foods, taste testing, and creating cafeteria promotional materials.

Behavioral Economic Strategies to Increase Fruit and Vegetable Selection and Consumption Among Youth

Ten studies of behavioral economic strategies in schools investigated their effectiveness in increasing fruit selection and consumption among K-12 grade students in schools. One study tested the strategy of offering more than one type of fruit at lunchtime and found that fruit consumption significantly increased by kindergarten through eighth grade children, as measured by observation and plate waste weighing.[6] This finding was supported by four other studies.[35-38] A cross-sectional study within fourteen elementary schools concluded that slicing or precutting fruit for second and third grade students was positively associated with greater fruit consumption.[7] Other investigators have tested the effect of slicing apples and oranges during lunch and found elementary students selected and consumed significantly more sliced oranges than uncut, yet there was no effect of slicing apples on students' selection and consumption over the whole apple.[39] In contrast, a study of middle school students found that selection and consumption of apples increased when they were sliced.[40] A cross-sectional study of middle and high school students found that when the visual appearance of fruit was rated "good or excellent," the odds of students self-reporting consumption of fruit at school increased.[8] Another cross-sectional study of eighth, tenth, and twelfth grade students found that fruit consumption was greater in high schools serving fruit from nine or more locations/sources, regardless of venue type compared to schools with fruit available in three or fewer sources, 51% to 45%, respectively.[41]

Studies have also investigated behavioral economic strategies designed to increase vegetable selection and consumption among students in K-12 grades. In one study, investigators found that having two or more vegetable options was positively associated with greater consumption of vegetables among second and third grade students.[7] In another study, Bucher et al[42] reported that children between the ages of seven to ten who were given a choice of two vegetables served themselves significantly more vegetables than children offered only carrots or only beans. Among kindergarten through eighth grade students, one study found that offering more than one kind of vegetable at lunch significantly increased consumption of vegetables.[6] Another study reported that when the visual appearance of vegetables served at school was rated "good or excellent," the odds of middle and high school students self-reporting that they consumed vegetables at school were greater.[8] Similarly, Terry et al[41] reported that high school students' consumption of vegetables was greater when they were offered vegetables from nine or more locations within the school cafeteria compared to availability at three or fewer venues.

Salad bars have also been used as a behavioral economic strategy to promote vegetable and fruit selection and consumption.[43,44] However, the research literature shows mixed results on the impact of school salad bars on selection and consumption of fruits and vegetables among school children. For example, Terry-McElrath et al[41] assessed associations between the presence of salad bars and student fruit and vegetable intake and found that consumption of green vegetables was 7% greater when salad bars were present. Another study reported increased odds of vegetable consumption (OR = 1.48) among students in schools with salad bars compared to consumption by students without salad bars in their schools.[8] In addition, another study concluded that there was a significant increase in frequency of fruit and vegetables consumed after introduction of a fruit and vegetable salad bar along with education, marketing, and field trips.[45] However, other studies have reported mixed results. For example, Bean et al[46] reported that exposure to salad bars increased selection, but decreased fruit and vegetable consumption by 0.65 cups among first through fifth graders. A study led by Adams et al[35] found that the presence of salad bars was not associated with greater fruit and vegetable consumption by fourth and fifth grade students, yet the number of fruit and vegetable items on the salad bar was associated with the greater consumption. Johnson et al[38] reported that median cups of fruits and vegetables consumed per student was higher in schools without a salad bar (0.76 cups),

compared to schools with a salad bar (0.50 cups). In fact, according to Adams et al,[47] "no rigorous randomized trials have examined whether salad bars increase students' [fruit and vegetable] consumption." (p. 37)

Healthy Eating Barriers and Facilitators for Adults

The focus of the second intervention is young adults. To guide the design of this intervention it was important to understand barriers and facilitators to healthy eating for adults.[48] A literature search was performed within National Institutes of Health PubMed.gov search engine to identify studies assessing barriers and facilitators to healthy eating among adults (19-60 years old). Twenty-seven articles were selected as relevant because they contained a study population whose ages ranged from 19-60 year old, were from a country which consumes a westernized diet (USA, Australia, Scotland, United Kingdom, etc.), and represented the general population rather than a specific population subset such as people who are pregnant, homeless, or those on special diets as a result of disease. Table 1 lists the studies and their characteristics. The studies represent the United States (13), Scotland (5), Australia (4), Europe (2), Switzerland (2), and the United Kingdom (1). Fifteen of the 27 studies used quantitative methods such as surveys to collect information from the sample, ten of the studies used qualitative approaches such as focus groups, and two used a mixed-methods approach employing both quantitative and qualitative methods to gather information from the sample.

Table 1. Characteristics and findings of research studies assessing healthy eating barriers and facilitators for adults (19-60 years old)

Citation	Study Title	Data Collection Methods	Sample size, Ages, Country	Barriers identified	Facilitators identified
Palmer, et al., 2020[49]	Putting Knowledge into Practice: Low-Income Women Talk about Food Choice Decisions.	Focus groups and survey collected information: food security, health behaviors, self-efficacy	N=36, low-income women, 19-50, USA	Cost, Convenience, Nutrition guidelines hard to follow	Equipment to make healthy food fast, Canned/Frozen foods, Desire to feed family healthy, Ability to apply nutrition knowledge
Pinho et al., 2018[50]	Exploring barriers to meeting recommendations for fruit and vegetable intake among adults in regional areas: A mixed-methods analysis of variations across socio-demographics.	Self-reported open ended barriers questions related to intake of fruit and vegetables	N=5649, 18-71+, Australia	Cost, Convenience, Taste, Lack of access	None identified
Ingrid K. Richards Adams et al., 2019[51]	An Examination of Demographic and Psychosocial Factors, Barriers to Healthy Eating, and Diet Quality Among African American Adults.	Social support, self-efficacy, healthy eating barriers, diet quality assessed	N=100, African American adults,18-74, USA	Cost, Convenience	Ability to apply nutrition knowledge, Social Support

Table 1 (cont'd)

Zeratsky, et al., 2018[52]	Meal Planning Program to Reduce Barriers and Improve Diet Quality in Worksite Wellness Center Members.	Six week supermarket savvy program, met 4-7 times per week. Study survey assessing nutrition knowledge, diet quality, healthy eating barriers	N= 86, 22-78, USA	Cost, Convenience, Lack of nutrition knowledge	Does not perceive price as a barrier
McMorrow, et al., 2017[53]	Perceived barriers towards healthy eating and their association with fruit and vegetable consumption.	Perceived healthy eating barriers and self-reported fruit/vegetable consumption	N=8319, 16-75, Scotland	Cost, Convenience, Taste, Lack of nutrition knowledge	None identified
Garcia, Reardon, et al., 2017[54]	Evaluation of the "Eat Better Feel Better" Cooking Programme to Tackle Barriers to Healthy Eating.	Six week program, 62 of 117 completed baseline and post intervention questionnaire 17 of the 117 completed a 4 month follow-up questionnaire	N=117, 16-45+, Scotland	Cost, Convenience, Lack of nutrition knowledge, Lack of cooking skills, Fear of wasting food	None identified

Table 1 (cont'd)

Macdiarmid, et al., 2013[55]	"It was an education in portion size". Experience of eating a healthy diet and barriers to long term dietary change.	Participants provided with a healthy diet for three day. Semi-structured interviews conducted Subjects recruited from four health systems.	N=50, 19-63, Scotland	Cost, Convenience, Competing priorities	Planning ahead, desire to cook
Rolnick et al., 2009[56]	Focus groups inform a web-based program to increase fruit and vegetable intake.	Focus groups held to evaluate healthy eating perceptions, barriers to Fruits and vegetables	N=137, 21-65, USA	Cost, Convenience, Lack of access, Nutrition guidelines hard to follow	Ranking personal health as highly important, Perceiving self as role model
Hampson, et al., 2009[57]	A social marketing approach to improving the nutrition of low-income women and children: an initial focus group study.	Seven focus groups, discussed shopping, eating out and at home	N= 74 low-income women caring for young children, 18-29, USA	Cost, Convenience, Taste	None identified

Table 1 (cont'd)

Ylitalo, et al., 2019[58]	The Veggie Van: Customer characteristics, fruit and vegetable consumption, and barriers to healthy eating among shoppers at a mobile farmers market in the United States.	Assessed food purchasing behaviors, barriers to healthy eating	N=192, 30-64, USA	Cost	None identified
Duthie, et al., 2018[59]	Effect of increasing fruit and vegetable intake by dietary intervention on nutritional biomarkers and attitudes to dietary change: a randomised trial.	Randomized to either usual diet or diet supplement assessed levels of fruits and vegetables associated with nutritional biomarkers and, assessed to barriers fruit and vegetable intakes	N=45 (19 men 26 women, 39-58, Scotland	Cost, Lack of access	None identified
Nicklas, et al., 2016[60]	Association between barriers and facilitators to meeting the Dietary Guidelines for Americans and body weight status of caregiver-child dyads: the Healthy Eating and Lifestyle for Total Health Study.	Assessed barriers and facilitators with meeting dietary guidelines with questionnaire	N=836 caregiver-child dyads, 31-47, USA	Cost, Taste, Lack of cooking skills	Availability, Accessibility, Affordability

Table 1 (cont'd)

Griffith, et al., 2016[61]	Differences in Perceptions of the Food Environment Between African American Men Who Did and Did Not Consume Recommended Levels of Fruits and Vegetables.	64 interviews, discuss perceptions and beliefs related to eating fruits and vegetables for health reasons	N= 64 African American men, 35-76, USA	Cost, Lack of nutrition knowledge, Lack of access, Lack of will power	Perceive eating fruits and vegetables as easy
Williams, et al., 2012[62]	Optimising women's diets. An examination of factors that promote healthy eating and reduce the likelihood of unhealthy eating.	self-report survey assessing dietary factors and associations with eating behaviors	N=1013 women, 28-52, Australia	Cost	Ability to apply nutrition knowledge, Social Support
Bucher Della Torre, et al., 2019[63]	Eating Habits of Professional Firefighters: Comparison With National Guidelines and Impact Healthy Eating Promotion Program.	Participants in a healthy eating program, food intake and eating behaviors collected at baseline and 1 year follow-up	N= 28, 33-46, Switzerland	Convenience, Competing priorities, Motivation	None identified
Smith, et al., 2016[64]	Factors influencing food preparation behaviours: findings from focus groups with Mexican-American mothers in southern California.	Four focus groups assessed food preparation behaviors and influences	N=21 mexican American mothers, 25-46, USA	Convenience	Ability to apply nutrition knowledge

Table 1 (cont'd)

Traill, et al., 2012[65]	Attitudinal and demographic determinants of diet quality and implications for policy targeting.	Survey assessing attitudes towards dietary guidelines	N= 250, 18-85, UK	Convenience	Ranking personal appearance and personal health as highly important
Welch, et al., 2009[66]	Is the perception of time pressure a barrier to healthy eating and physical activity among women?	Survey of barriers related to healthy eating and physical activity	N=1580 women, 18-70, Australia	Convenience, Lack of access	None identified
Kearney, et al., 1999[67]	Perceived barriers in trying to eat healthier--results of a pan-EU consumer attitudinal survey.	Assess perceived barriers to eating a healthy diet	N=1000, 15-55+, Europe	Convenience, Taste	None identified
Mete, et al., 2019[68]	What is healthy eating? A qualitative exploration.	Assessing definitions of healthy eating and perceptions of healthy food barriers and facilitators	N=23, 25–60, Australia	Nutrition guidelines hard to follow, Competing priorities	Social Media used as inspiration, Ability to apply nutrition knowledge
Pinho et al., 2018[50]	Exploring the relationship between perceived barriers to healthy eating and dietary behaviours in European adults.	Associations between healthy eating perceived barriers and dietary behaviors	N=5900, 36-68, Europe	Taste, Family taste preferences, Lack of willpower	Ability to apply nutrition knowledge, Does not perceive time as a barrier, Does not perceive price as a barrier

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Table 1 (cont'd)

Jilcott Pitts et al., 2015[69]	Associations between neighborhood-level factors related to a healthful lifestyle and dietary intake, physical activity, and support for obesity prevention polices among rural adults.	Perceived barriers to healthy eating, neighborhood barriers and their association with dietary behaviors and physical activity	N=366 rural North Carolina adults, 43-67, USA	Lack of access	None identified
Suplee, et al., 2015[70]	Exploring the Challenges of Healthy Eating in an Urban Community of Hispanic Women.	Cross sectional study to assess eating patterns and access to food	N=48 urban Hispanic women, 23-73, USA	Lack of nutrition knowledge	None identified
Leslie, et al., 2014[71]	What, not just salad and veg? Consumer testing of the eatwell week.	Assess understanding of eatwell week messages	N=35, 16-85, Scotland	Lack of nutrition knowledge, Nutrition guidelines hard to follow	None identified
Van der Horst, et al, 2011[72]	Ready-meal consumption: associations with weight status and cooking skills.	Survey assessing beliefs about ready-made meals	N=1017, 37-65, Switzerland	Lack of cooking skills	None identified
Zunker et al., 2008[73]	Using formative research to develop a worksite health promotion program for African American women.	Four focus groups assessing job factors related to body weight, life factors, and amount of physical activity	N=14, 33-55, USA	Lack of social support, Stress	None identified

Table 1 (cont'd)

		Four focus groups assessing knowledge awareness of cardiovascular disease and barriers to healthy eating			
Folta et al., 2008[74]	Factors related to cardiovascular disease risk reduction in midlife and older women: a qualitative study.		N=38 women, 40-80+, USA	Taste, Lack of menu planning, Pressure to eat at social events	None identified

Barriers to Eating Healthy Foods

Table 2 summarizes barriers and frequency to healthy eating reported in selected studies. Sixteen barriers to consuming healthier foods were identified from the 27 studies. Cost[49,51-54,59,62,75 55-57,60,61] and convenience (preparation time, busy schedules) [49,51-57,63-67,75] were the most frequently cited barriers influencing healthy food choices and were each cited by 14 out of the 27 studies. The third most frequently cited barrier was taste, which was cited by seven of the 27 studies.[50,53,57,60,67,74,75] Lack of nutrition knowledge was the next most frequently cited barrier in six of the 27 studies.[52-54,61,70,71] Limited availability/ lack of access to healthy foods [56,59,61,69,75] as well as nutrition guidelines being perceived as unachievable and/or hard to follow[49,56,68,71,74] were each reported by 5 of the 27 studies. Prioritization/competing priorities [55,63,68] and lack of cooking skills[54,60,72] were each reported by 3 of the 27 studies. Lack of motivation to eat healthy foods,[53,63] family taste preferences for less healthy foods,[49,50] fear of wasting healthy foods,[54,74] and lack of willpower to choose healthier foods over less healthy foods [50,61] were each cited by two of the 27 studies. The remaining four barriers, lack of social support,[73] work stress,[73] lack of menu planning,[74] and pressure to eat less healthy food at social events,[74] were each reported by one out of the 27 studies.

Table 2. Summary of healthy eating barriers and the frequency of barriers being reported in selected studies

Barrier	Frequency of barrier being reported in selected 27 studies
Cost	14
Convenience/preparation time/busy schedules	14
Taste	7
Lack of nutrition knowledge	6
Limited availability/ lack of access	5
Nutrition guidelines unachievable/hard to follow	5
Prioritization/Competing priorities	3
Lack of cooking skills	3
Motivation	2
Family taste preferences	2
Waste	2
Lack of willpower	2
Lack of social support	1
Stress (work stress)	1
Lack of menu planning	1
Pressure to eat at social events	1

Similar dietary barriers have also been reported in systematic reviews. Zorbas et al[76], investigated factors perceived to influence healthy eating among adults. Their review included 39 articles from an initial retrieval of 10,690 records and focused on people 18 years and older. The inclusion criteria required that studies be qualitative, conducted with adults in high-income countries, and focused on healthy eating. They used a meta-ethnographical approach to compare themes and context between studies. A meta-ethnographic approach compares the selected literature to identify and translate key themes. Their analysis revealed that time limitations, social environment, cost, taste, lack of knowledge related to food and nutrition, lack of clear understanding of what makes up a healthy diet, mental stress, not having a meal preparation plan, and lack of cooking skills were barriers to healthy eating. Zorbas et al[76] also identified the following personal beliefs and attitudes as barriers: distrust of nutrition guidelines, dieting misinformation, and belief that fruits and vegetables contain pesticides. Another barrier identified is the idea of "passive consumption." This is where people, in particular men, describe eating foods made available to them and not having much control over what is prepared.[76]

Similar barriers were also reported in a systematic review by Kelly et al[77] which analyzed 28 qualitative studies, 11 cohort studies and 46 systematic reviews to identify facilitators and barriers related to physical activity, diet and eating behaviors among middle aged adults (40-64 years). The authors report that key barriers related to diet were the lack of understanding of health messages, lack of time, perceived cost, lack of availability, motivation, and skills related to preparing healthy foods.

Cost of healthy foods was a leading barrier mentioned in the literature. For example, Palmer et al[49] captured this sentiment from a 49 year old mother, *"The stuff that's good for you is too expensive. You can't afford [it] so you have to go back to what you can afford. That's what you do, especially when you have children."* Cost was also reported as one of three top barriers, along with convenience and lack of time to prepare healthy foods in a study of 100 African Americans[51] Not surprisingly, cost tends to be reported more often within populations with less income. For example, an Australian study of 5649 aged adults reported that cost and availability of fresh fruit and vegetables were most cited barriers among rural and lower income individuals.[75]

Cost and time to prepare fruits and vegetables were also the most frequently cited barriers to consuming fruits and vegetables in a randomized control trial evaluating the effect of mobile produce markets among 201 participants (mean age of 45 years old) in 12 North Carolina communities. Self-efficacy of the study participants was lowest for purchasing and trying new fruits and vegetables.[78] Similarly, in a randomized control trial of 45 adults between the ages of 39-58 years, reported barriers to fruit and vegetable consumption were inconvenience, cost, and volume of healthy food required to consume to be considered healthy. Taste was also reported by participants as being the most common influence on their fruit and vegetable purchasing.[59]

Convenience, preparation time and busy schedules were also leading barriers identified in additional literature reviewed. For example, in a study by Smith et al[64] focus group results were analyzed from 21 Mexican American women between the ages of 25-46 in southern California. Time pressures and busy schedules were consistently reported by participants and were described as barriers to trying new recipes, cooking in general, and using preprepared foods as time saving strategies. One participant from this study stated. *"It takes time and it's hard to find the time, so you go to what you already know how to make."* Time was also identified by Livingstone et al[75] as the overall most important theme for 5649 participants taking part in a

study exploring barriers to meeting fruit and vegetable dietary recommendations. Participants reported that vegetables take too much time to prepare and fruits are messy requiring more preparation time. Participants also reported difficulty finding time to prepare and consume recommended levels of vegetables and fruit. Moreover, in a study by Folta et al[74] who conducted four focus groups with 38 women 40 years and older, participants reported that time was the top barrier to purchasing and preparing heart healthy foods.

Taste is also a major barrier reported in the literature. For example, in a sub-sample of the Scottish Health Survey, 8404 adults over the age of 16 years of age completed a knowledge, attitudes, and motivation survey. Among women and men, 16.4% and 10.4%, respectively, reported not liking the taste of healthy foods or finding them too boring. Moreover, among women and men who reported not liking the taste of healthy foods or finding them boring, they were significantly less likely to meet the fruit and vegetable recommendation ($p = 0.00$, $p = 0.02$, respectively).[53] In a study by Pinho et al[50] who evaluated perceived barriers to healthy eating of 5900 European adults; respondents reporting taste as a barrier were two times as likely as those not reporting this barrier to consume more fast food during the week. In a study by Folta et al,[74] who conducted four focus groups with 38 women 40 years and older, participants reported that taste preferences for heart healthy foods were a barrier to eating them. For example, one participant stated, "*You know, you can lead a horse to water but can't make him drink. I try to cook healthy and try to have healthy things . . . but I like fried foods too, so it's hard.*" Lastly, taste as a barrier to healthy eating is also supported by another review of literature investigating healthy eating within the restaurant setting. The review evaluated 20 articles published between 2011 to 2016 and found that healthy foods were perceived by restaurant costumers as having less pleasant flavors, linked to higher prices and being less satiating.[79]

Another barrier reported in the literature is that nutrition guidelines are seen as unachievable and/or hard to follow. For example, female focus group participants reported confusion over nutrition related health messages.[74] In another qualitative study from Australia exploring healthy food choices, semi-structured interviews were conducted with 23 participants between the ages of 25 and 60 years old. Participants reported that healthy eating messaging is confusing and unclear. For example, one participant reported, *"There's so much different information out there ... you're almost paralysed by those choices because you're afraid of*

choosing the wrong one and if you make a good one and it's all good, you're happy but if you make a bad one..."[68] Furthermore, in another qualitative study, 137 focus group participants from the United States between the ages of 21 and 65 reported that health recommendations seem to change creating confusion and provided the example *"an apple a day is not good enough, now it's 5 a day."*[56] These findings are supported by results of a systematic review conducted by Kelly et al,[77] who reported that a lack of understanding of health messages were barriers to healthy eating and that clear and simple messages are preferred.

Facilitators to Eating Healthy Foods

Regarding facilitators, a total of 16 facilitators were identified from the 27 research articles and are listed in table 3. The most frequently cited facilitator was self-efficacy and the ability to apply nutrition knowledge, which was reported in six of the 27 studies.[49-51,62,64,68] Having social support[51,62] and ranking personal health as highly important[65,56] were each reported in two of the 27 studies. The remaining facilitators were each reported by one study of the 27 articles reviewed: having equipment (e.g. blender) to make healthy food fast;[49] using canned and/or frozen foods;[49] having a desire to feed healthy foods to family;[49] finding inspiration from social media;[68] not perceiving time and cost as a barrier;[50] perceiving eating fruits and vegetables as easy;[61] perceiving healthy foods as available, accessible, and affordable;[60] ranking personal appearance as highly important;[55] and perceiving self as a role model.[56]

Table 3. Summary of healthy eating facilitators and the frequency of facilitators barriers being reported in selected studies

Facilitators	Frequency of facilitator being reported in selected 27 studies
Self-efficacy/Ability to apply nutrition knowledge	6
Social Support	2
Rank personal health as highly important	2
Equipment (blender) to make healthy food fast	1
Canned/Frozen foods	1
Desire to feed family healthy	1
Social Media used as inspiration	1
Does not perceive time as a barrier	1
Does not perceive price as a barrier	1
Perceive eating F/V as easy incorporate in a meal	1
Availability	1
Accessibility	1
Affordability	1
Planning ahead	1
Rank personal appearance as highly important	1
Perceive self as role model	1

Systematic reviews support the facilitators identified in the 27 research articles reviewed. For example, Zorbas et al[76] reported the following facilitators: having accurate nutrition knowledge, easy to access and tailored healthy eating information, a desire to feel good, and a sense of self-efficacy. Kelly et al[77] systematic review also identified similar facilitators: having a personal health concern; supportive environment; having clear and simple dietary messages; and having access to easy-to-use websites were facilitators to healthy eating. Since eating occurs as a social activity, social support, availability of foods, and preferences for healthy foods were also reported as facilitators.[76] In fact, the idea that having a supportive social environment contributing to healthy eating is also supported by a systematic review completed by Nicholls et al[80] who investigated healthy eating facilitators among nurses. They reported that workplaces can facilitate healthy eating by offering more healthy eating opportunities such as easy to access salad bars, ready-made sandwiches, and pleasant eating environments. In addition, if nurses engaged with colleagues about diet and exercises it was reported that there was a motivational effect to adopt healthier habits. Lastly, in another review, Murray et al[81]

investigated facilitators required to maintain healthy behaviors among adults and reported that providing social support with a friend produces more success among those attempting behavior change by themselves.

Self-efficacy and the ability to apply nutrition knowledge is a leading facilitator identified in the literature. For example, results from focus groups conducted by Palmer et al[49] reveal that interventions should focus less on educating people on nutrition facts and focus more on developing an individual's ability to purchase, prepare tasty healthy food in a cost effective manner. For instance, one focus group participant reported that *"... If I'm feeding myself, I'll get something to shove in the microwave, I don't care."* Another participant stated that *"My problem is once I'm hungry, I want something fast. Like I don't want to have to cook, you know the quickest possible thing that sounds good."* These statements illustrate how enhancing skill development in selecting quick tasty healthy meals and snacks might increase a person's ability to consume healthy foods.[49] Moreover, popular diets such as Atkins, Weight Watchers, Jenny Craig take advantage of the desire for this type of procedural knowledge and skills by promoting the application of nutrition knowledge to real life.[68] In fact, a person's level of self-efficacy has been shown to be positively corelated with Healthy Eating Index Scores.[82]

Social Support is also a facilitator to healthy eating reported in the literature. Adams et al report that several studies have identified an association between social support and higher diet quality.[51] For example, a study by Williamson et al[83] surveyed 1013 Australian women and reported that those with greater family support for healthy eating were more likely to be high consumers of fruits (≥ 2 servings/day (OR 0.09 (1.05–1.14) p = 0.00)) and vegetables (≥ 3 servings/day (OR 1.10 (1.06–1.15) p = 0.00)). Murray et al[81] identified 97 factors from 22 studies investigating lifestyle factors in people at high risk for cardiovascular disease and reported social support from family and friends as an important facilitator to healthy eating. The authors created a relationship map to illustrate how factors are interrelated. Social support factors related to five categories demonstrating that social support may be an important facilitator in integrating healthier behaviors into everyday life.[81]

Ranking one's personal health as highly important was also reported in the literature as a facilitator. For example, a study of 250 adults from the United Kingdom investigating healthy eating attitudes among a sample between the ages of 18-85 years old. Individuals rating personal health as highly important compared to those that do not, were significantly more

likely to report healthier eating (Coefficient 0.47 (SE 0.125), p <0.001).[65] In another study of 137 adults ages 21-65 in United States, focus group results revealed that having a concern for personal (or family) health were motivators for fruit and vegetable intake.[56]

In summary, sixteen barriers to healthy eating were identified in this review of the literature, with the most frequently cited barriers being cost, convenience (including preparation time and busy schedules), taste, and lack of nutrition knowledge. Less frequently cited barriers included: limited availability and lack of access, nutrition guidelines perceived as unachievable or hard to follow, ability to prioritize and having competing priorities, lack of cooking skills, motivation to eat healthier foods, family taste preferences for less healthy foods, fear of wasting food, lack of willpower and social support, work stress, and lack of menu planning.

Sixteen facilitators to healthy eating were identified in this review of the literature, with the most frequently cited facilitators being self-efficacy and having the ability to apply nutrition knowledge, having social support, and ranking personal health has highly important. Less frequently cited facilitators included: having equipment (blender) to make healthy food fast, using canned/frozen foods, having a desire to feed family healthy foods, using social media as inspiration, not perceiving time or cost as a barrier, perceiving eating fruits and vegetables as easy to incorporate in a meal, having the availability, accessibility and affordability, being able to plan ahead, ranking personal appearance as highly important, and perceiving self as a role model.

Dietary Intake of College Students/Emerging Adults

The second intervention described in this dissertation worked with young adults to improve their dietary patterns. Thus, a literature search was conducted to identify dietary intakes among this group. The first observation from this search is that it was challenging to find studies specifically aimed at describing the dietary patterns or intake levels of people between the ages of 18 and 25 years. For example, in 2021, the U.S. Department of Agriculture Food Surveys Research Group analyzed NHANES 2017-2018 data to describe adult intake of fruits and vegetables. However, they did not separate out adults into an 18–25 year old age group in their analysis. This research revealed that for the entire sample of those 20 years and older, only 6 out of 10 adults reported consuming vegetables daily. Adults 20-39 years of age reported the lowest consumption of vegetables daily (55%), compared to 40–59-year-olds

(60%), and the 60 plus age group (62%), with differences between the genders - 47% of men and 62% of women reported consuming vegetables daily.[84] U.S. adult fruit intake is also low and less than 50% of U.S. adults report consuming fruit daily. Adults 20-39 years of age reported the lowest consumption of fruit daily (36%), compared to 40-59 year olds (42%), and the 60 plus age group (51%).[85] In addition, the National Center for Chronic Disease Prevention and Health Promotion[25] report that only 1 out of every 10 adults consume the recommended levels – for fruit 2-2.5 cups/day (1.5-2 cup equivalents/day); for vegetables 3-4 cups/day (2-3 cup-equivalents/day).[1]

But what about the dietary intake among younger adults, 19–24-year-olds? To answer this question, a more systematic literature review was conducted using PubMed (nih.gov). The first step of this review attempted to locate review articles summarizing research investigating dietary patterns of 19–24-year-olds. A search was conducted for articles with human subjects in English and using the phrase "dietary intake, eating patterns" produced 52,712 results. Further filtering to include subjects between the ages of 19-24 years reduced the number of articles to 9,780. Adding the phrase "United States" to the search further reduced the number of articles produced to 2,507. Among the 2,507 results, 41 review articles were discovered; 8 were systematic reviews, 24 were review articles, and 9 were meta-analysis.' However, none of the articles specifically evaluated dietary patterns of young adults without disease or comorbidities, as this dissertation research aimed to accomplish. Rather, the articles investigated specialized populations such as individuals with eating disorders, transgender youth, youth with suicidal behavior, youth with binge eating behavior, and youth with obesity. Further refinement of the search produced nine articles that included intake amounts of healthier foods such as fruits and vegetables among university students from the United States and are listed in Table 4.

Table 4. Studies evaluating intakes of fruits/vegetables among young adults (18-25 years)

Citation	Country, Sample size, Age	Dietary assessment tool(s) used	Intake of fruits (F), vegetables (V), or other food group
Landry et al., 2019[86]	U.S., Hispanic college freshmen (n=92), 18 to 19 years.	24-hour dietary recalls. Dietary quality calculated using the Healthy Eating Index (range: 0-100)	HEI average total score 54.9 +/- 13.4.. Total fruit, whole fruit and whole grains lowest HEI component scores.

Table 4. (cont'd)

Ha & Caine-Bish, 2009[14]	U.S., N=80, 18-24 years	3-day food record	Mean intakes: Vegetables 0.77 cups/day +/- 0.62; Fruits 0.94 cups/day +/- 0.92.
Clifford, Anderson, Auld, & Champ, 2009[87]	United States, N= 101 college students enrolled in university	National Cancer Institutes (NCI) Health Habits and History Questionnaire	Combined F/V intake ranged from 2.75 (SE = 0.25) to 2.82 cup equivalents/day (SE= 0.25).
Ma et al., 2002[88]	United states (10 states), cross-sectional study, 1545 surveys, 18-24 years old	NCI Health Habits and History Questionnaire	Number of fruit servings per day among groups: 2.3 +/- 1.3 (group 1), 2.4 +/- 1.4 (group 2), 2.6 +/- 1.7 (group 3), 2.9 +/- 1.7 (group 4). Number of vegetable servings per day: 2.6 +/- 1.5 (group 1); 2.4 +/- 1.4 (group 2); 2.8 +/- 1.6 (group 3); 3.0 +/- 1.6 (group 4).
Kattelmann et al., 2014[89]	N= 1639, college students, from 13 campuses	NCI Fruit and Vegetable Screener	Total fruit and vegetables cup equivalents mean intakes per day: 2.6 ± 2.1 cups.
Rodgers et al., 2016[90]	U.S., N=43, 18.96 years (SD = 0.76)	Two items from Food Frequency Questionnaire assessed fruit and vegetable intake at baseline.	Number of servings of fruit per day 2.14 +/-1.09. Number of servings of vegetables per day 2.50 +/- 1.01.
Odum & Xu, 2019[91]	U.S., 1503 undergraduate students,	Four questions assessed fruit and vegetable consumption	Mean number of days students reported consuming fruit, in previous 7 days: 3.87, SD = 1.93. Mean number of days students reported consuming vegetables in previous 7 days: 3.84 days, SD = 2.04
Shive & Morris, 2006[92]	N= 1367 randomly selected community college students	Fruit intake assessed using a survey assessing how many portions were consumed the previous day on a "typical" day	Number of daily "typical" fruit servings reported by students: 1.7 (SD=1.3)

Table 4 includes eight studies reporting student dietary intakes for young adults between the ages of 18 – 25 years living in the United States. One out of the eight studies reported students consuming fruits and vegetables in serving amounts closer to the "5-a-day" recommendations.[93] The study recruited 1545 18–24 year-old university students from 10 states and reported mean daily fruit servings between 2.3 and 2.9 servings per day and mean daily vegetables servings between 2.4 – 3.0 servings for groups reporting the lowest and highest intake levels, respectively.[88]

However, seven of the eight studies reported that young adult diet quality and specifically fruit and vegetable intake were below recommended levels. For example, in a study by Landry et al[86] the dietary intake of 92 U.S. college freshmen were evaluated using the Healthy Eating Index-2015 (HEI-2015). The HEI-2015 measures diet quality by evaluating how well dietary intake aligns with the 2015-2020 Dietary Guidelines for Americans. The HEI-2015 consists of 13 components which can be summed to total 100 points. A higher score indicates that a diet aligns more closely with the U.S. Dietary Guideline recommendations. The average American total HEI-2015 score is 58 and the average score for young adults between 19-30 years of age is 53.[94] In this study, the average Healthy Eating Index-2015 score was 54.9 +/- 13.4, with 51% scoring between 51 and 80 and 48% scoring less than 51. The total fruit, whole fruit and whole grain components had the lowest HEI-2015 component scores.

In studies reporting intake amounts in cups per day, young adults consumed below the recommended levels for fruits and vegetables. For example, Ha et al[14] who analyzed dietary intake in 80 U.S. college students, reported that 72% of students consumed less than 1 cup of total vegetables daily, 90% consumed less than 1 cup of fresh vegetables daily, 92% consumed less than 2 cups of total fruit daily, and 90% consumed less than 1 cup of fresh fruit daily.[14] In a study with 1639 college students from 13 campuses, mean total fruit and vegetable intake was 2.6 ± 2.1 cups per day,[89] well below the Dietary Guideline recommended levels of 4.5 cup equivalents (1.5–2 cup-equivalents of fruits and 2–3 cup-equivalents of vegetables daily).

In three studies using unique and less robust dietary assessment methods young adults reported servings of fruits and vegetables on the low end of recommended servings of fruit and vegetables. For example, in a study by Rodgers et al,[90] two questions from a food frequency questionnaire were used to assess the number of servings of fruit and vegetable servings per day among 1367 community college students. In this study, students reported 2.14 +/-1.09 servings

of fruit per day and 2.50 +/-1.01 servings of vegetables per day.[90] In another study where fruit intake was assessed using a 4-item survey developed by the researchers, participants reported consuming 1.5 (SD=1.4) servings of fruit each day.[92] Lastly, in a study with 1503 U.S. undergraduate students, the authors created four questions to assess how many days out of a 7 day period students consumed fruits and vegetables. The mean number of days students reported consuming fruits and vegetables in the previous seven days was 3.87 (SD = 1.93) and 3.85 (SD=2.04).[91]

College nutrition course as dietary behavior change strategy

A literature review was conducted to better understand the effectiveness of university level classroom-based dietary interventions for young adult college students and identified a total of seven articles that used a semester long college course as an intervention component/strategy to improve dietary behaviors of college students. Three of the seven articles reported on the same classroom-based nutrition intervention with the same sample but evaluated different dietary outcomes (fruits/vegetables, soft drink/milk, and whole grains) for each article. The following table provides details of the five studies including the intervention approach, study design, dietary assessment tool used, and dietary outcomes.

Table 5. University nutrition courses as interventions to improve dietary behaviors among college students

Author, Year	Semester long course type	Study design, Duration	Dietary Assessment tool	Sample, Country	Dietary change outcomes
Matvienko et al., 2001[11]	Nutrition science	Pre/post, Randomized control trial, 16 months	Food frequency questionnaire	N=40, U.S.	Significant difference from control group at end of intervention in kcals/day - control group 2244.3 ± 1000; intervention group 1729.8 ± 691.2 (p = .013)
Brown et al., 2011[12]	General nutrition course	Pre/post intervention, 16 weeks	Food frequency questionnaire	N=376, U.S.	No changes in avg total vegtable intake.

Table 5. (cont'd)

Hager et al., 2012[13]	General health and wellness course	Pre/post intervention, 15 weeks	Centers for Disease Control and Prevention Behavioral Risk Factor Surveillance System Survey questions	N=2971, U.S.	Increase in vegetable consumption by 4%, comparing pre versus post (F = 19.0; p < .001), Whole grain cereal consumption increased by 8% comparing pre versus post (F= 36.7; p < .001), brown rice/ whole wheat consumption increased by 11% comparing pre versus post (F = 62.3; p < .001)

Table 5. (cont'd)

| Hekler et al., 2010[95] | Food Society (FS) course and Human biology (HB) course | Pre/post intervention, 15 weeks | Food frequency questionnaire | FS course N=28, HB course 72, U.S. | Healthful diet score: HB course did not have significant changes in mean healthful diet score pre versus post course. HB Pre 3.1±1.6 versus HB post 3.3±1.6. The FS course did have significant changes in mean healthful diet score pre FS 3.3±1.5 versus post 4.0±1.6 ($p<0.05$);

Fruit: No significant changes in the number of fruit servings per week pre versus post in either the HB or FS courses

Vegetables: Significant increase in vegetables servings per week in FS course FS pre 27.9±19.3 versus FS post 25.5±17.4 ($p<.05$). No significant increase vegetable servings per day in HB course pre versus post |
|---|---|---|---|---|---|

Table 5. (cont'd)

Ha & Caine-Bish, 2009[14]	Introductory nutrition course	Pre/post intervention, 15 weeks	3 day dietary record	N=80, U.S.	Significant increases in total vegetables cups/day pre .77 +/- .62 versus post 1.52 +- 1.03 (p<.001) and in total fruit cups/day pre .94+/-.92 post 1.33+/-.99. (p<.005)
Ha et al., 2009[16]					
Ha & Caine-Bish, 2011)[15]					Increase in fat free milk mean fluid ounces/day intake pre 1.06 +/- 0.71 versus post 4.23 +/-1.18 (p= 0.010)
					Increase in intake of whole grain ounces/day pre 0.4 +/- 0.6 versus post 1.2 +/- 1.0, (p< .001)

The classroom-based nutrition interventions presented in Table 5 varied in course type, course content, dietary assessment tools, and outcome measures, making it difficult to compare results across studies. The type of course varied within studies, with the majority of interventions (three of the five) teaching students through a general introductory college course.[11,12,14-16] One study taught students in a general health and wellness course [13] and another study taught students in a food and society course.[95]

The course content also varied between studies. For example, in the study by Matvienko et al[11] the course content included topics such as teaching about trends in overweight, determining energy needs, and how excess energy is stored as adipose tissue. In the studies by Ha et al[14, 16, 15] the topics taught included benefits of fruits and vegetables, cardiovascular diseases, cancer, diabetes, obesity, osteoporosis, and hypertension, how to read labels, identify whole grains, and healthy recipes. Brown et al[12] taught general education nutrition topics in addition to learning how to select, store, and prepare vegetables.[12] Hager et al[13] taught topics such as general wellness, cardiorespiratory fitness, strength and flexibility, injury prevention, cardiovascular health, nutrition, weight management, first aid, substance abuse, cancer, stress

management, and personal safety. Lastly, Heckler et al[95] taught topics such as environmental ethics, social justice, cultural, political, and agricultural issues related to food and food production.

Four of the five studies reported small but positive outcomes across many of the dietary measures. For example Matvienko et al[11] reported that there was a significant difference from the control group at the end the intervention in kcals/day (control group 2244.3 ± 1000; intervention group 1729.8 ± 691.2 ($p = .013$)). Hekler et al[95] reported that there were significant changes in mean healthful diet score in the Food Society Course, pre 3.3 ± 1.5 versus post 4.0 ± 1.6 ($p<0.05$) and in the number of vegetables servings per week, pre 27.9 ± 19.3 versus post 25.5 ± 17.4 ($p< .05$). Hager et al[13] reported that compared to pre intakes post vegetable intake increased by 4% ($F = 19.0$; $p < .001$), whole grain cereal increased by 8% ($F= 36.7$; $p < .001$), and brown rice/ whole wheat increased by 11% ($F = 62.3$; $p < .001$).[13]

One out of the five studies reported results with the greatest magnitude of changes pre versus post intervention. The intervention produced significant changes in total cups of vegetables pre (0.77 ± 0.62) versus post (1.52 ± 1.03) ($p<.001$) and total cups of fruit pre (0.94 ± 0.92) versus post (1.33 ± 0.99), as well as significant increases in cups of fresh fruits and vegetables pre versus post ($p<.005$).[14-16]

Two of the five studies reported no changes in specific dietary outcome measures. For example, Brown et al[12] reported that there were no changes in average total vegetable intake pre versus post-test.[12] Hekler et al[95] reported that there were no significant changes in the Human Biology course pre versus post for healthful diet score, number of vegetable and fruit servings per week. Hekler et al also reported that fruit servings per week pre versus post did not change pre versus post in the Food and Society Course.

In summary, research with college level courses as dietary interventions with college aged students is rare. Many of the existing studies with college level courses as dietary interventions reported small but positive dietary outcomes, with one study reporting more substantial changes in dietary outcomes pre versus post intervention. Existing studies lend credibility to the idea that a college level nutrition course may be part of an intervention strategy to improve dietary behaviors of young adults attending college.

Agents of Change

<u>*Use of Agents of Change Within Dietary Interventions*</u>

        This dissertation research employs the use of "agents of change" in both interventions. Although the use "agents of change" within interventions is not new and found in various disciplines throughout the literature, its use within the field of nutrition interventions is minimal. A literature search was performed to explore the use of "agents of change" and "change agents" within nutrition interventions among school aged youth and college students. The literature review aimed to identify research with school aged youth in school cafeterias and with college students acting as agents of change with their family and/or friends. A search within the PubMed search engine (https://pubmed.ncbi.nlm.nih.gov) using phrases "agents of change" or "change agent" resulted in 17 studies listed in table 6. There were no studies that focused on young adults between the ages of 19-24 years acting as agents of change. Fifteen of the studies discovered involved adults/parents acting as agents of change with young children between the ages of 3 and 13 years of age and two studies involved children acting as agents of change with their parents. None of the studies discovered through this review, used college aged students acting as change agents to convey nutrition information to family members/friends or used school food service professionals acting as change agents to improve the school cafeteria environment. Table 6 summarizes the research from this literature search.

Table 6. Summary of "agent of change" healthy eating interventions in the literature

Citation	Title	Sample Size, Age	Country, Study Type: Randomized Control Trial (RCT)	Intervention	Results
Ashton et al. 2021[96]	Dietary Outcomes of the 'Healthy Youngsters, Healthy Dads' Randomised Controlled Trial	N=125 fathers; N =125 children; Fathers as agent of change	Australia, RCT	Effect of family-based lifestyle intervention on father and child dietary intake.	No significant differences between the intervention and control groups for fathers or children for fiber (g/day), vegetables (% of total energy intake), and fruit (% of total energy intake).

Table 6. (cont'd)

Arredondo et al., 2018[97]	Latina mothers as agents of change in children's eating habits: findings from the randomized controlled trial Entre Familia: Reflejos de Salud	N= 361 families; Mothers as agents of change	U.S., RCT	Effect of intervention aimed at modifying parent health behaviors to influence child dietary behaviors.	Children in the intervention group increased the number of monthly varieties of vegetables consumed compared to control group (Intervention group mean: 12.6 SE=.42; Control mean 11.3, SE= .42, P=.03). Children in the intervention group decreased their daily servings of sugar-sweetened beverages (Intervention Mean: 1.02 SE = .10; Control Mean 1.38 SE=.10; P=.02)
Wald et al., 2018[98]	An Interactive Web-Based Intervention to Achieve Healthy Weight in Young Children	N= 73 parent/child dyads; Parents as agents of change	U.S., RCT	Effect of parent nutrition education on child BMI and parent self-efficacy.	No significant differences in outcome measures between groups
Østbye et al. 2012[99]	Parent-focused change to prevent obesity in preschoolers: results from the KAN-DO study	N = 400 mother child dyads; Mothers as agents of change	U.S., RCT	Effect of lifestyle behaviors on maternal parenting behaviors, diet, and child's physical activity and weight status.	No significant differences in outcome measures between groups

Table 6. (cont'd)

Heerman et al. 2017[100]	Parenting Self-Efficacy, Parent Depression, and Healthy Childhood Behaviors in a Low-Income Minority Population: A Cross-Sectional Analysis	N= 601 parent child dyads; Parents acting as agents of change	U.S., Cross sectional	Associations between parenting self-efficacy, preschool behaviors	No significant correlations between parenting self-efficacy and child Healthy Eating Index score. Greater parenting self-efficacy was significantly negatively correlated with having fewer meals in front of television ($\rho=-0.17$; $p<0.001$).
White et al. 2006[101]	Promoting healthy behaviors to prevent chronic disease in Panama and Trinidad & Tobago: results of the women as agents of change project	N= 100 women as agents of change.	Panama and Trinidad & Tobago, Pre-post intervention; pre-post intervention	Effect of six week education program on participants and their families.	Only descriptive statistics reported. No statistical tests performed comparing the number of daily servings of fruits and vegetables pre versus post intervention.
Hawkins et al. 2020[102]	Design and Implementation of a 5-Year School-Based Nutrition Education Intervention	N=100 teachers N= 800 elementary school students; teachers as agents of change	U.S., pre-post intervention	Effect of nutrition lessons on child nutrition	N/A Design protocol

Table 6. (cont'd)

Gadhoke et al. 2015[103]	"Cause it's family talking to you": Children acting as change agents for adult food and physical activity behaviors in American Indian households in the Upper Midwestern United States	In-depth interviews with six adults and six children (10-13 years of age); children as agents of change	U.S., In-depth qualitative interviews	Formative research for a pilot obesity prevention program	Children currently act as agents of change with their adult caregivers. Children receive support from family and community social networks; have secure bonds with family members; have a sense of belonging and self-esteem and self-efficacy related to change agency; are capable to convey health knowledge to caregivers.
DeSmet et al. 2017[104]	Asking behaviors among 9–11 year-old children, increasing home availability/ intake of fruit and vegetables	N=400; children as agents of change	U.S., RCT	10 episode vi deogame on child fruit/veg asking beh aviors	At-home fruit and vegetable asking behavior score and availability significantly increased post intervention compared to baseline, $t = 8.12$, $(p < .0001)$, $t = 14.46$, $(p < .0001)$, respectively.

Although the previous literature search did not produce many nutrition intervention related agent of change studies, there are examples of agent of change research outside the nutrition intervention field. For example, a national Black Barbershop Health Outreach Program (BBHOP) successfully used the agent of change approach by training African American barbers to screen and raise community awareness around cardiovascular diseases. Since its creation, BBHOP has screened more than 7000 African American men in 20 cities within the US.[105] An example from the cancer health education literature tested delivery of cancer care strategies with either text messaging or peer navigators (agents of change); cancer care seeking behaviors significantly increased compared to the control group among the text message and peer navigator groups.[106]

There are also examples of interventions where college students act as agents of change.[107] In fact, Collins et al report that there is strong evidence in the literature showing university students can be effective at teaching, reinforcing, and modeling behaviors among their peers.[108] University students have served as peer educators on college campuses in a variety of roles such as to encourage peers to use less alcohol, establish healthy relationships, and seek mental health services.[109] In one study by Seitz et al[110] students acted as agent of change to bring about changes in campus tobacco policy compliance. In this study, 49 students took photos of campus tobacco policy violations and held a public exhibit advocating for tobacco policy compliance. As a result, ashtrays were relocated throughout campus and increased compliance with the school's tobacco policy was observed.

As previously mentioned, much of the literature using the term "agent of change" or "change agent" are interventions involving parents delivering information to their children but some interventions worked with children as the agents of change acting on parent behavior. Kelly et al[111] identified 16 studies where children acted as agents of change with adults to increase health behaviors such as screening for cancer, HIV/AIDS, hypertension, and infectious disease prevention.[103,104,112-124] Two of the 16 studies were related to healthy eating and are listed in the previous table (table 6).[103,104] Kelly et al also described the breadth of agents of change research as having a "wide focus" and illustrated this point by creating the following table listing the number and focus of quantitative and qualitative studies where children were acting as agents of change.

Table 7. Studies as identified and reported by Kelly et al which include children acting as agents of change[111]

Focus of study	Quantitative	Qualitative	Target(s) for behavior
Cancer screening	1		Adult family relatives
Diet and physical activity		1	Adults
Fruit and vegetable intake	1		Children asking behaviors, home fruit and vegetable availability
HIV and/or AIDS	1		Adult beliefs and children's effectiveness to teach
Hypertension awareness	1		Parent and/or guardian seeking care
Infectious disease prevention	1	1	Knowledge, trust, practices
Schoolchildren as health change agents		1	Community support
Vector-borne disease (e.g., malaria)	4	1	Knowledge, attitude, practices, health communication
Water preservation	1	2	Knowledge, attitudes, behaviors

In regards to the two studies that focused on healthy eating, one study was a qualitiative study and investigated how children can act as agents of change with their adult caregivers.[103] This study reported that children are already acting as agents of change with their adult caregivers and that they are capable of conveying health knowledge to caregivers. The second study was a randomized control trial which investigate if children completeing an online 10 episode video game education program increased their fruit and vegetable asking behaviors and availability of at-home fruits and vegetables.[104] The authors reported that children at-home fruit and vegetable asking behavior score and at-home availability significantly increased post intervention compared to baseline, t = 8.12, (p < .0001), t = 14.46, (p < .0001), respectively.

In summary, the use of agents of change" is not a new idea and appears across the health behavior and health communication intervention literature. However, their use within the field of nutrition intervention research appears to be limited. Nutrition interventions using agents of change typically involve adults/parents acting as agents of change with young children between the ages of 3 and 13 years of age. No studies discovered from this literature review worked with

school nutrition professionals to act as agents of change with students and/or college students acting as agent of change to convey nutrition information to family members/friends.

Summary

To prevent chronic diseases and maximize health during any stage of life, dietary interventions can employ strategies to shift dietary patterns to include more fruit, vegetables, whole grains, legumes, nuts and seeds. Interventions can also focus on specific life stages: children and adolescents (5 -18 years of age) and those 18-24 years of age (emerging/young adults).

Leveraging individuals to deliver elements of an interventions may be a possible strategy to convey behavior change information in others. For example, investigators can train people to act as "agents of change" with other individuals. These agents of change can be professional or lay people who help others initiate and/or maintain healthy behaviors. They can be community health workers, extension professionals, school food service providers, health coaches, and college students. Agents of change can benefit interventions by being able to provide more time with individuals participating in the intervention compared to clinicians, adding credibility and salience to intervention messaging, and increasing the reach of the intervention.[125]

This research investigated using an agent of change approach to increase selection and consumption of healthy foods within two populations: 1) 5–18-year-olds attending public schools and 2) young adults between the ages of 18–25 years enrolled in a public university. In addition, this research addresses research gaps within both these populations by evaluating the effectiveness of encouraging healthy eating among school aged youth through the use of a behavioral economic scorecard tool within public schools as well as evaluating the effect of college students acting as agents of change with their friends and family on college student nutrition knowledge and dietary behaviors.

CHAPTER 3 - THE IMPACT OF A SMARTER LUNCHROOM PROGRAM ON SELECTION OF FRUITS AND VEGETABLES BY CHILDREN IN SCHOOL CAFETERIAS

Introduction

All children benefit from healthy eating. Consuming a diet rich in nutrient-dense whole foods is protective against diet related chronic diseases later in life.[126] Conversely, it is recognized that consuming a diet rich in refined energy-dense foods is associated with development of chronic diseases such as cardiovascular disease, Type 2 diabetes, and cancers.[126] In the United States, children are not meeting federal dietary guidelines.[27] For example, children 4 to 18 years of age do not consume adequate amounts of dark green leafy vegetables, beans, whole grains, and whole fruit.[27] However, younger children, 4 to 8 year-olds, do consume appropriate amounts of whole fruit.

Schools make an ideal environment to reach youth and encourage selection and consumption of healthy foods and beverages. In the U.S., over 50 million students attend public schools annually, and approximately 30 million students participate in the National School Lunch Program.[127] With the passage of the Healthy Hunger Free Kids Act (HHFKA) of 2010, higher standards for school meal programs and strategies to alleviate childhood hunger were introduced. One component of the HHFKA requires schools to serve more vegetables within dark green, red/orange, and legume subgroup classifications, and more whole fruit. Schools may offer flavored low-fat milk, and unflavored milk is required to be available at each school meal service. One-half of weekly grains must be whole-grain rich. However, getting the 30.4 million students participating in the program each year to select and consume these healthier items is a challenge.

Schools can also provide an important venue to engage students and generate peer-to-peer strategies to increase student acceptance of healthier foods.[128] It is theorized that schools can promote greater student health by finding ways to involve and build stronger connections with students.[130] For example, school staff can engage students by sharing decision-making, as well as collecting and incorporating student feedback. Findings from a qualitative investigation of factors influencing children and adolescent food consumption reported that programs attempting to improve nutrition among children and adolescents should make a point of gathering student input.[131]

Behavioral economics is a field of study that uses strategies gleaned from the fields of economics, psychology, and marketing to change behaviors such as increasing healthy food and beverage selection,[132] increasing patient adherence to medication regimens,[133] and increasing levels of physical activity.[134] Cornell University's Center for Behavioral Economics in Child Nutrition Programs has grouped 100 approaches for use within the school cafeteria setting in a document titled "Smarter Lunchroom Self-Assessment 2016 Scorecard" (Scorecard). The most recent iteration of the Scorecard released in 2019 contains 60 strategies.[135] These strategies can be attractive to school foodservice providers because they are low to no-cost, and relatively simple to implement within the school lunchroom. Strategies include offering at least two types of vegetables daily, moving fruit to all points of sale, serving sliced fruit, and moving the salad bar to a highly visible high-traffic area.

Table 8 presents the current literature associated with the fruit and vegetable strategies listed on the Scorecard and used in our research project. It also includes citations for research studies related to each strategy and conducted in a school setting with students from kindergarten to twelfth grade. Surprisingly, there is limited evidence supporting the efficacy and effectiveness of many of these strategies. For example, less than half of the 27 fruit and vegetable strategies (12) used in this study were found to have research evidence of their effectiveness. Among these 12 fruit Scorecard strategies, 10 studies were found to have investigated six of these strategies. Among the 15 vegetable strategies listed on the Scorecard, 11 studies were found to provide evidence for effectiveness of six of these strategies.

It is important to better understand if these strategies can lead to an increase in student selection of healthier choices. This paper describes the results from a Smarter Lunchroom Scorecard intervention designed to increase selection of fruits and vegetables by students in Michigan school cafeterias from 2015 to 2017. We investigated whether coaching child nutrition professionals to implement Smarter Lunchroom strategies in their cafeterias resulted in improvements in Scorecard scores, if school characteristics were associated with Scorecard improvements, and whether improved Scorecard scores were associated with increased student selection of fruits and vegetables.

Table 8. A summary of the reviewed literature on fruit and vegetable strategies listed on the smarter lunchrooms self-assessment 100 point scorecard*

Strategies	Research Studies Addressing Strategy
Fruit Strategies (n = 12)	
At least two types of fruit are available daily	36,35,46,6,38
Sliced or cut fruit is available daily	7,39,40
Fruit options are not browning, bruised or otherwise damaged	8
Fruit is available at all points of sale service line, snack windows, a la carte lines etc.	41
Daily fruit options are available in at least two different locations on each service line	41
At least one daily fruit option is available near all registers	41
Daily fruit options are easily seen by students of average height for your school	No studies found in peer-reviewed publications
Daily fruit options are given creative, age appropriate names	No studies found in peer-reviewed publications
Whole fruit options are displayed in attractive bowls or baskets instead of chaffing/hotel pans	No studies found in peer-reviewed publications
A mixed variety of whole fruits are displayed together	No studies found in peer-reviewed publications
Daily fruit options are bundled into all grab and go meals available to students	No studies found in peer-reviewed publications
Daily fruit options are written legibly on menu boards in all service and dining areas	No studies found in peer-reviewed publications
Vegetable Strategies (n = 15)	
At least two types of vegetable are available daily	35, 7, 42, 6
Vegetables are not wilted, browning, or otherwise damaged	8
At least one vegetable option is available in all foodservice areas	41
Individual salads or a salad bar is available to all students	35, 36, 46, 8, 38, 45, 41
The salad bar is highly visible and located in a high traffic area	36, 47, 42,

Table 8. (cont'd)

Self-serve salad bar utensils are at the appropriate portion size or larger for all fruits and vegetable offered	No studies found in peer-reviewed publications
Self-serve salad bar utensils are smaller for croutons, dressing and other non-produce items	No studies found in peer-reviewed publications
Daily vegetable options are available in at least two different locations on each service line	41
Daily vegetable options are easily seen by students of average height for your school	No studies found in peer-reviewed publications
A daily vegetable option is bundled into grab and go meals available to students	No studies found in peer-reviewed publications
A default vegetable choice is established by pre-plating a vegetable on some of the trays.	No studies found in peer-reviewed publications
Available vegetable options have been given creative or descriptive names	No studies found in peer-reviewed publications
All vegetable names are printed/written on name-cards or product IDs and displayed next to each vegetable option daily	No studies found in peer-reviewed publications
All vegetable names are written and legible on menu boards	No studies found in peer-reviewed publications
All vegetable names are included on the published monthly school lunch menu	No studies found in peer-reviewed publications

*"The Cornell Center for Behavioral Economics in Child Nutrition Smarter Lunchroom Self-Assessment 2016 Scorecard"

Methods

The Michigan State University's Human Subjects Institutional Review Board granted permission for this study and classified it as exempt.

Participants

Child Nutrition Directors across Michigan were invited to participate in a smarter lunchroom mini-grant program. Thirty-eight Child Nutrition Directors representing 81 school buildings applied to the program and were selected on a first come first serve basis. Child

Nutrition Directors either assigned building managers, lead cafeteria workers, or worked directly themselves with a Michigan State University (MSU) Extension Community Nutrition Instructor (CNI) trained in using the Smarter Lunchroom Scorecard coaching strategies. The Director and the MSU Extension CNI signed an agreement to complete the following grant requirements between November 2015 and June 2017: Form a student team (of at least two students) to assist with completion of the Scorecard and making cafeteria changes; 2) Complete an online Smarter Lunchrooms training module; 3) Complete a Smarter Lunchrooms Scorecard and provide five days of production records before and after changes to the cafeteria were made; 4) Review the results of the Smarter Lunchrooms Scorecard and with input from at least two students, select either all of the "Focusing on Fruit" strategies (12) or all of the "Promoting Vegetables and Salad" strategies (15) listed on the Scorecard to implement in their cafeterias; 5) Spend $250 on Smarter Lunchroom related activities; and 6) Submit a success story highlighting student accomplishments and changes made to the cafeteria. The MSU Extension CNIs were trained and certified as Smarter Lunchroom Technical Assistance Providers by Cornell University's Food and Brand Lab Smarter Lunchroom Regional Coordinators. Coaching for the Child Nutrition Director, building manager, or lead cafeteria worker by the CNI included: assisting with completing the Scorecard (pre- and post-changes), determining what changes would be made to the cafeteria, using mini-grant funds to support strategies chosen, providing location based oversight, and working alongside student teams.

Instruments and Data Collection

Smarter Lunchrooms Scorecard

The 100 strategy Smarter Lunchroom Scorecard (Scorecard) developed by Cornell's Food and Brand Lab in 2016 was used in this study. It contained one hundred strategies grouped in the following sections: Focusing on Fruit (12 strategies), Promoting Vegetables and Salad (15 strategies), Moving More White Milk (9 strategies), Entrée of the Day (8 strategies), Increasing Sales Reimbursable Meals (16 strategies), Creating School Synergies (11 strategies), Lunchroom Atmosphere (18 strategies), Student Involvement (5 strategies), Recognition & Support of School Food (3 strategies), and Ala Carte (3 strategies). If a strategy is practiced, the child nutrition professional checks a box next to the strategy. The total number of strategies checked are counted to generate to total score. Total scores between 71-100 are categorized as

"Gold," between 51-70 as "Silver," and those between 30-50 as "Bronze." MSU CNIs worked with the Child Nutrition Professional at each school to complete the Scorecard prior to, and after making cafeteria changes. The Child Nutrition Professionals were asked to check off the statements that were true for their school cafeterias. Boxes that were not checked off during the pre-assessment were considered as areas for improvement. Scorecards were reviewed for completeness and accuracy, and entered into a web-based data entry form using SurveyMonkey Inc., by trained research assistants at Michigan State University (MSU). Seventy-four schools completed the pre-Scorecard with 71 schools completing the post-Scorecard. Sixty-seven schools completed both pre- and post-Scorecards. Total Scorecard scores and total scores for each Scorecard section were determined for each school by summing the number of boxes checked in each section of the Scorecard.

Food Production Records

All public schools are required to complete daily lunch food production records which include a detailed accounting of what foods and beverages were served that day and in what quantities. Child Nutrition Directors from districts with participating schools were asked to submit five days of production records prior to and after changes were made in the cafeteria. One set of production records (pre- and post-cafeteria changes) was submitted for each participating school. Although the format of the production record varied among the participating districts, each record contains similar information and can be used to determine which foods, and how much of each food was selected by students, and how much remained after lunch service finished. Food items reported in the production records may have been different pre- versus post-changes made to the cafeteria. For example, a school may have reported serving oranges before changes were made, and sliced apples after changes made as the fruit menu items. Most schools reported serving sizes in cups, but if pounds or cans were used as a measuring unit, number of grams per pound and cup per gram conversions were determined using the USDA Food Composition Database to generate total cups, and cups per student values.[136] Five-day average cups of fruit and vegetables served per student was determined for each school pre- and post-intervention. Production records were reviewed for completeness and accuracy by trained MSU research assistants and entered into a standardized form using Excel. If discrepancies or questions about the production record arose, the Child Nutrition Director was

contacted and interviewed using a standardize list of questions to improve data quality. Thirty schools submitted production record data pre- and post-cafeteria changes.

Data Analysis

Data were analyzed using StataCorp Statistical Software: Release 10 (a statistical software package for researchers). Mean Scorecard values were compared to post values using a two-sided paired t-test, with significance testing at $p<0.05$. Regression analyses were conducted to determine whether percent of children eligible for free or reduced priced meals, school grades, student teams, community eligibility provision, or participation in outside healthy schools programming were significantly associated with improvements in Scorecard scores. Mean values of five-day average cups of fruits and vegetables selected per student were calculated for pre- and post-intervention and compared using a two-sided paired t-test. A regression analysis was conducted to determine if schools improvement in overall Scorecard Scores was associated with greater increases in cups of fruits and vegetables selected.

Results

Of the 67 schools that completed both pre- and post-Scorecard data, 40 (59.7%) included grades kindergarten through fifth grades; six (9.0%) enrolled students in grades six, seven, or eight; ten schools (14.9%) included grades nine through twelve; five (7.5%) included grades kindergarten through eight, and six buildings (9.0%) included sixth through twelfth grades. The total number of students attending the 67 schools was 30,348 students. Forty of the schools (59.7%) served student populations in which at least 51% of their student body was eligible for free or reduced priced meals.

Results from the two-sided t-tests suggests a significant increase ($p<0.5$) between mean pre- and post-Scorecard total scores across all school grade groups regardless of the percentage of students participating in the school meal program groups, and whether or not a student team was or was not formed (Table 9).

Table 9. Mean changes in smarter lunchroom scorecard scores by school characteristics (n=67)

Categories		Sample Size	Mean[a] Pre-Score Standard Error (SE[c])	Mean[a] Post- Score (SE[c])	Mean[a] Change	P-value[b]
School Grades	K-5 [d]	40	47.9 (2.0)	63.73 (14.8)	15.9	0.00
	6-8 [d]	6	54.5 (4.2)	67.17 (4.5)	12.7	0.01
	9-12[d]	10	52.4 (4.4)	68.10 (3.2)	15.7	0.00
	K-8 [d]	5	41.4 (8.2)	60.40 (8.6)	19.0	0.03
	6-12[d]	6	50.0 (5.3)	65.33 (4.5)	15.3	0.02
Percent Free/Reduced Price Meals	<25%	7	44.6 (3.0)	65.14 (4.9)	20.6	0.00
	26-50%	20	52.4 (2.9)	69.65 (3.0)	17.3	0.00
	51 -75%	22	50.4 (2.9)	64.05 (3.1)	13.6	0.00
	76-100%	18	44.6 (3.1)	59.39 (3.0)	14.8	0.00
Schools That Formed Student Teams	With	57	49.2 (1.8)	65.4 (1.8)	16.2	0.00
	Without	10	46.9 (2.6)	60.0 (4.2)	13.1	0.00
Total		67	48.8 (1.6)	64.6 (1.7)	15.7	0.00

[a] Mean Scorecard values were compared to post values using a two-sided paired t-test, with significance testing at p<0.05. Maximum Scorecard value was 100.
[b] All p-values shown are significant at a p-value < 0.05
[c] Standard error (SE) is used to describe the confidence levels around the mean. The standard error includes both the standard deviation and the sample size. SE = Standard Deviation/√(sample size).
[d] K -5 (Kindergarten through fifth grade); 6-8 (Sixth grade through eighth grade); 9-12 (Ninth through Twelfth grade); K-8 (Kindergarten through eighth grade); 6-12 (Sixth through Twelfth grade)
Note: "Percent Free/Reduced Price Meals" refers to the percentage of students who participate in the National School Lunch Program and qualify for free and/or reduced priced meals.

Fruit and vegetable selection by students from production record data by school grades, percent school meal participation, and formation of student team appear in Table 10. Thirty-seven schools provided complete pre-production record data, and 31 of these schools provided complete post-production record data. There were 30 schools with both pre-and post-production records used for statistical analysis. There was one statistically significant change for the elementary and middle grade group (p=0.03), with an increase in the cups of fruit selected by students, as measured by the production records, before and after the implemented changes.

Table 10. Five-day mean selection of cups of fruits and vegetables per student by school (n=30) characteristics

Categories		Sample Size	Mean Pre-cups/ student Fruit (SE[b])	Mean Post-cups/ student Fruit (SE[b])	Mean Fruit Change cups/ student Fruit (SE[b])	p-value[a]	Mean Pre-cups/ student Veg (SE[b])	Mean Post-cups/ student Veg (SE[b])	Mean cups/ student Veg (SE[b])	p-value[a]
School Grades	K-5[c]	18	0.5 (0.0)	0.5 (0.1)	0.0	0.56	0.6 (0.6)	0.6 (0.1)	0.0	0.90
	6-8[c]	1	0.0	0.0	0.0	--	0.1	0.2	0.0	--
	9-12[c]	4	0.4 (0.2)	0.4 (0.2)	0.1	0.42	0.5 (0.1)	0.6 (0.1)	0.1	0.45
	K-8[c]	5	0.3 (0.1)	0.4 (0.1)	0.1	0.03[a]	0.5 (0.1)	0.5 (0.1)	0.0	0.94
	6-12[c]	2	0.5 (0.3)	0. 6 (0.3)	0.0 -	0.20	0.3 (0.0)	0.3 (0.1)	0.0	0.94
Percent Free/Reduced Price Meals	<25%	2	0.3 (0.1)	0.4 (0.0)	0.1	0.35	0.3 (0.0)	0.3 (0.0)	0.0	0.93
	26-50%	10	0.3 (0.1)	0.2 (0.1)	0.1	0.10	0.5 (0.1)	0.4 (0.1)	0.2	0.12
	51 -75%	7	0.6 (0.1)	0.7 (0.1)	0.1	0.07	0.6 (0.1)	0.8 (0.1)	0.2	0.10
	76-100%	11	0.5 (0.1)	0.6 (0.1)	0.2	0.06	0.5 (0.1)	0.7 (0.1)	0.1	0.38
Schools That Formed Student Teams	With	28	0.4 (0.0)	0.5 (0.6)	0.1	0.26	0.5 (0.1)	0.6 (0.1)	0.0	0.63
	Without	2	0.6 (0.1)	0.7 (0.2)	0.1	0.41	0.4 (0.1)	0.3 (0.2)	0.1	0.63
Total of All Schools		30	0.4 (0.0)	0.5 (0.1)	0.1	0.29	0.5 (0.1)	0.6 (0.1)	0.0	0.68

[a] Results significant at a p-value < 0.05.
[b] Standard error (SE) is used to describe the confidence levels around the mean. The standard error includes both the standard deviation and the sample size. SE = Standard Deviation/√(sample size).
[c] K -5 (Kindergarten through fifth grade); 6-8 (Sixth grade through eighth grade); 9-12 (Ninth through Twelfth grade); K-8 (Kindergarten through eighth grade); 6-12 (Sixth through Twelfth grade)
Note: Menus may have been different for pre vs post production record data collection.

A regression analysis was performed to determine if schools with improvement in overall Scorecard score demonstrated greater increases in cups of fruits and vegetables selected per student. Of the 67 schools with paired pre- and post-Scorecard scores and the 30 schools with paired pre- and post-production records, a total of 29 schools submitted both pre- and-post Scorecard and pre- and post- production record data. There were no statistically significant associations between changes in Scorecard score, fruit and vegetable scores, and cups of fruits ($p=0.48$), vegetables ($p=0.54$), and fruit and vegetable combined ($p=0.48$) selected by students (data not shown).

Discussion

This study found that a program which paired MSU Extension Community Nutrition Instructors with school nutrition professionals in an effort to improve Smarter Lunchroom Scorecard scores led to an increase in these scores in Michigan school cafeterias. However, we also found that improvements in Smarter Lunchroom Scorecard scores did not translate to increased selection of fruits and vegetables by children during lunchtime. Because it is reported that thousands of schools across the U.S. are implementing some aspect of the Scorecard, it is important to understand the evidence regarding Scorecard strategies. Our review of the literature found limited evidence supporting the efficacy and effectiveness of many of these strategies.

While some of the studies assessing effectiveness of the Scorecard strategies used in this study for increasing student selection and consumption of fruits and vegetables ("Focusing on Fruit" with 12 strategies and "Promoting Vegetable and Salad" with 15 strategies) have shown positive results, other studies investigating these strategies have either not been conducted (to our knowledge), have shown mixed results, or have not included school characteristics in the assessment. For example, age of students,[39] type of fruit and vegetable offered,[137] availability of other food in the environment,[138] and attitudes of adult staff serving food[139] all appear to influence selection and consumption. It is also important to note that the above studies were conducted prior to implementation of the Healthy, Hunger-Free Kids Act of 2010.

One study tested the influence of the strategy of offering more than one type of fruit at lunchtime and found this significantly increased consumption of fruit by kindergarten through eighth grade children, as measured by observation and plate waste weighing.[6] This finding was also supported by four other studies.[35-38] A cross-sectional study within fourteen elementary

schools concluded that slicing or precutting fruit for second and third grade students (another Scorecard strategy) was positively associated with greater fruit consumption.[7] Other investigators have tested the effect of slicing apples and oranges during lunch and found elementary students selected and consumed significantly more sliced oranges than uncut, yet there was no effect of slicing apples on students' selection and consumption over the whole apple.[39] In contrast, a study of middle school students found that selection and consumption of apples increased when they were sliced.[40] In a cross-sectional study of middle and high school students, it was reported that when the visual appearance of fruit was rated "good or excellent," the odds of students self-reporting consumption of fruit at school increased.[8] In another cross-sectional study of eighth, tenth, and twelfth grade students, it was reported that fruit consumption was greater in high schools serving fruit from nine or more sources, regardless of venue type compared to schools with fruit available in three or fewer sources, 51% to 45%, respectively.[41] No published research was found to have tested the six other fruit strategies listed on the Scorecard among school aged youth, including fruit being easily seen by students; providing age appropriate names for fruit; displaying a variety of fruit together; bundling fruit in a grab-n-go option; and writing fruit options legibly on a menu board.

Among the vegetable strategies listed on the Scorecard, to our knowledge, only six of the 15 strategies have been studied in the school setting. In one study, investigators found that having two or more vegetable options was positively associated with greater consumption of vegetables among second and third grade students.[7] Bucher et al[42] reported that children between the ages of seven to ten who were given a choice of two vegetables served themselves significantly more than children offered only carrots or only beans.[42] Among kindergarten through eighth grade students, one study found that offering more than one kind of vegetable at lunch significantly increased consumption of vegetables.[6] Another study reported that when the visual appearance of vegetables served at school was rated "good or excellent," the odds of middle and high school students self-reporting that they consumed vegetables at school were greater.[8] Similarly, Terry-McElrath et al[41] reported that high school students' consumption of vegetables was greater when they were offered vegetables from nine or more locations within the school cafeteria compared to availability at three or fewer venues.[41] Any studies of strategies regarding self-serve salad bar utensils, daily vegetable options in at least two different locations,

bundled or pre-plated vegetable options, and naming of vegetables in the school cafeteria setting have not been published.

Four of the 15 vegetable strategies assessed in this study relate to salad bars, which have also been promoted by the Let's Move Salad Bars to Schools initiative.[43,44] One study concluded that there was a significant increase in frequency of fruit and vegetables consumed after introduction of a fruit and vegetable salad bar along with education, marketing, and field trips.[45] Another study found increased odds of vegetable consumption (OR = 1.48) among students in schools with salad bars compared to consumption by students without salad bars in their schools (Gosliner, 2014). Terry-McElrath et al[41] looked at associations between the presence of salad bars and student fruit and vegetable intake and found that consumption of green vegetables was 7% greater when salad bars were present. However, Bean et al,[37] reported that exposure to salad bars increased selection, but decreased fruit and vegetable consumption by 0.65 cups among first through fifth graders. An earlier study led by Adams et al[35] found that the presence of salad bars was not associated with greater fruit and vegetable consumption by fourth and fifth grade students, yet the number of fruit and vegetable items on the salad bar was associated with the greater consumption In a more recent study, Adams et al[36] found that students at schools with salad bars inside the service line showed an increase in the amount of fruits and vegetables selected and consumed compared to students in schools with self-standing salad bars outside the line. Johnson et al[38] reported that median cups of fruits and vegetables consumed per student was higher in schools without a salad bar (0.76 cups), compared to schools with a salad bar (0.50 cups). In summary, many factors appear to influence the efficacy of Scorecard strategies related to salad bars. Moreover, according to Adams et al,[47] "no rigorous randomized trials have examined whether salad bars increase students' [fruit and vegetable] consumption." (p. 37).

Despite finding limited research supporting some of the individual fruit and vegetable strategies listed on the Scorecard, it is possible that bundling these strategies together, like our study did, creates a stronger effect. Three studies were found in the literature that combined strategies listed on the scorecard.[140-142] Greene et al[140] found that changes to the convenience, visibility, and attractiveness of fruits and vegetables within ten middle schools significantly increased fruit selection by 36% and consumption by 23%. Thompson et al[141] tested multiple strategies (labels, menu boards, slicing, etc.) in two elementary schools and did not find any significant increases in the number of students selecting or consuming fruits and vegetables,

except for the percentage of students selecting apples. Song et al[142] found that combining cafeteria environmental changes and nutrition education increased the self-reported consumption of fruit and vegetables by elementary school students.

This study investigated all 12 fruit and all 15 vegetable and salad strategies from the Scorecard had several limitations. First, the school sample was self-selected; thus schools that choose to participate may have been more likely to be supportive of making changes within the cafeteria than the general population of schools. Secondly, schools were not excluded based on changes previously made to their cafeterias; therefore schools entering the program may already had made changes listed on the Scorecard. Schools from the same district were included in the sample which could have led to bias based on leadership values. Another limitation was the lack of a comparison group and randomization. For example, because of the lack of a comparison group, the investigators cannot be certain if increases in Scorecard scores resulted from how the Scorecard may have been completed or whether other external factor(s) or outside influence(s) led to improvements. Moreover, the fact that the schools were not randomized prevents the findings from being generalizable to other schools outside of those participating in this study. In addition, given that all 12 fruit and the 15 vegetable strategies were required to be implemented by participating schools, it is difficult to ascertain which specific strategy led to increases in Scorecard scores.

As noted earlier, the Scorecard has limitations as a research tool. The breadth and flexibility of the strategies included on the Scorecard allows for multiple ways these can be implemented. The flexibility makes it difficult to control "the intervention." For example, the strategy to display a mixed variety of whole fruit together could be implemented in many ways. One school might display oranges, bananas, and apples on a brightly colored farm-themed table top near the register, whereas another school may display one bowl of a variety of different colored apples. In both cases, the schools will have implemented the strategy successfully.

Furthermore, even though Extension CNIs completed the same Smarter Lunchroom Technical Assistance Provider training, each school district was paired with a different Extension CNI who assisted with completing the pre- and post-Scorecards. This may have resulted in variability in scoring approaches. Even though schools were "required" to complete all the fruit or all the vegetable strategies contained on the Scorecards, researchers relied on self-reporting to confirm that changes in the cafeteria were made.

Analyses of the production record changes also contributes limitations to the study. The production records were self-reported by school staff, and low compliance with submitting complete and useable production records may have also impacted results. Given that the implementation time period was lengthy, schools may have experienced staff changes, increased variations of strategy implementations, or other school-based decisions may have influenced school meal programming.

Conclusions and Application

An evidence-based understanding of the impact of the Smarter Lunchroom program and other behavioral economic strategies to improve selection and consumption of healthy foods are important. The results of this study demonstrated that continued investigation to identify effective school-based healthy eating programming using behavioral economic approaches is necessary. Our review of the evidence supporting each of the fruit and vegetable Scorecard strategies raises many questions. For example, which strategies and for which age groups do these work best? If strategies are done in concert and at greater "dosage", will a greater effect be observed? Do strategies work best if an outside community health worker assists a child nutrition professional in implementation? Should future iterations of the Scorecard only include strategies supported by research conducted within schools and among students in grades kindergarten through twelfth? Moreover, is there a need for identifying evidence-based strategies by grade level? Answering these questions may assist child nutrition professionals in identifying which strategies to implement to increase selection of fruits and vegetables.

The results also demonstrated the challenges in conducting school-based research such as collection of food production records, and controlling for external confounding variables such as type of menu choices being served, differences in leadership skills and style at each school site, support by child nutrition staff for making changes, student grade levels, con-current external health promotion events, etc. Despite these challenges, continued investigation to identify effective school-based programming using behavioral economic approaches is needed. Although this study found significant increases in reported Smarter Lunchrooms Scorecard scores, it was not evident that changes in Scorecard scores resulted in changes in fruit and vegetable selection. Further research is needed to identify effective strategies that will lead to behavior changes by students. Future work might implement only one strategy at a time in order to better control for

internal and external confounding variables and demonstrate how use of a specific strategy led to changes in selection of the target food or beverage in a particular setting.

       Finding effective strategies to encourage young people to select healthier foods remains an important endeavor. We encourage child nutrition professionals and researchers to further evaluate and test the effectiveness of behavioral economic approaches designed to improve selection and consumption of healthy foods by students.

CHAPTER 4 - BARRIERS AND FACILITATORS TO HEALTHY EATING AMONG YOUNG ADULTS

Introduction

Diet-related diseases are common and increasing worldwide.[143] In the U.S., over 50% of adults live with one or more diet related chronic disease.[1] An individual's dietary pattern may promote or slow the progression of chronic diseases.[144] Therefore, establishing healthy eating patterns early in life is important to prevent and delay chronic diseases progression over the life course.[145]

Young adulthood, between the ages of 18-25 years of age, is an important life stage for intervening to improve dietary patterns and prevent and/or delay the onset of future diet related chronic diseases.[5] The theory of emerging adulthood[146] argues that this life stage features identity exploration, instability, self-focus and is distinct neurologically.[147] Young adults make up 12% of the adult population in the United States.[10] As these adults age, they become more independent, solidify food preferences, develop cooking and food selection skills [148] and navigate social/cultural pressures related to their food choices.[149] Moreover, eating patterns established in this life stage have the added importance of influencing the young adult's development of chronic diseases as well as the food choices and behaviors of future young adult's offspring and family members.[150,151]

A subgroup among emerging adults are college students. Approximately 19 million young adults are enrolled in a college or university annually.[9] The dietary behaviors of college students are concerning; meal skipping, disordered eating, and high intakes of energy dense nutrient poor foods are prevalent.[152] In addition, food intakes among this group are below the recommended intake amounts for non-starchy vegetables, fruits, whole grains,[22] and legumes.[26] In two studies of college students, mean combined fruit and vegetable daily intake was 2.6 +/- 2.1 cups and 2.7 +/-2.3, which is below the recommended daily 4.5 cup equivalents of fruits and vegetables (1.5–2 cup-equivalents of fruits and 2–3 cup-equivalents of vegetables daily).[87,153]

Barriers and facilitators to healthy eating among adults are important to consider. Cost [49,51-54,59,62,75 55-57,60,61] and convenience (including preparation time and busy schedules) of healthier foods are the most frequently cited barriers to healthy eating.[49,51-57,63-67,75]. Other frequently cited barriers are taste[50,53,57,60,67,74,75] followed by lack of nutrition knowledge.[52-54,61,70,71] Additional barriers that appear in the literature include limited availability and lack of

access to healthier foods as well as competing priorities and lack of cooking skills.[54,60,72] The most frequently cited facilitators of healthy eating in the literature among adults are self-efficacy, the ability to apply nutrition knowledge,[49-51,62,64,68] having social support,[51,62] and rating one's personal health as highly important.[56,65]

To investigate dietary intakes, barriers and facilitators of healthy eating among young adults, and to inform the design of future nutrition interventions, a study of college students enrolled in an asynchronous online introductory human nutrition course at a midwestern university was conducted. Specifically, this study investigated: (1) college student dietary intake and (2) student characteristics associated with nutrition knowledge and consumption of healthy foods.

Methods

Data was gathered during the fall of 2021 from college students who were enrolled in a 14-week asynchronous introductory human nutrition course at a midwestern university in order to assess student dietary intake prior to taking the course, and to identify characteristics associated with nutrition knowledge and consumption of healthier foods. Students were asked to complete an electronic pre course survey, created in Qualtrics (https://www.qualtrics.com), at the beginning of the semester as part of the course curriculum. Students had access to the survey starting on the first day of classes and it was open for 29 days. The survey took about 20 minutes to complete.

The survey was comprised of questions from three validated questionnaires: Jones Nutrition Knowledge (JNN) questionnaire,[154] Dietary Screener Questionnaire (DSQ),[155] and the 1992 National Health Interview Survey.[156] Students were also asked to report their gender and age in years. The Jones Nutrition Knowledge questionnaire contains 63 questions (22 dietary guideline questions, 26 nutrition knowledge questions, and 15 nutrition related disease questions).The Dietary Screener Questionnaire (DSQ) was developed by the National Cancer Institute and is a short dietary assessment instrument containing 26 items and provides intake estimates for fruits and vegetables, dairy/calcium, added sugars, and whole grains/fiber.[155] Four questions from the 1992 National Health Interview Survey (NHIS) were also included in the survey. The NHIS is a national survey created by the Centers for Disease Control and Prevention and conducted by the U.S. Census Bureau.

The outcome variables for this study consisted of the nutrition knowledge score and dietary intake of whole grains (ounce equivalents), fiber (g), calcium (mg) total added sugars (tsp equivalents), dairy (cup equivalents), vegetables including legumes and excluding French fries (cup equivalents), fruits (cup equivalents), and added sugars from sugar-sweetened beverages (tsp equivalents). The nutrition knowledge score was calculated for each student by tabulating the total number of correctly answered nutrition knowledge questions and had a possible score range of 0-60. The DSQ dietary intake variables were calculated using the National Cancer Institute's publicly available SAS PROC Reg procedure for converting survey responses to the estimates of individual dietary intakes.[157]

Four predictor variables were generated from the responses to the National Health Interview Survey statements: 1) There are plenty of healthy foods that taste good, 2) It is easy to eat a healthy diet, 3) I get encouragement from my family or friends to eat more healthy food, 4) In general, healthy foods cost more than other kinds of food. For each of the statements, respondents could select from a four-point Likert scale: strongly agree, agree, disagree, and strongly disagree.

Other predictor variables of interest in this study were gender and age. The gender variable allowed students to select from male, female, "additional gender category," and "decline to answer." Students who selected "additional gender category" or "decline to answer" were dropped from analysis. The age question allowed students to report their age in years. This study was approved by the Michigan State University Institutional Review Board.

Statistical Analysis

Data was deidentified before analysis. Descriptive statistics, including frequencies, means and standard deviations were calculated for all variables of interest. SAS studio 3.81 (SAS Institute Inc) was used for all analyses. Simple and multivariate linear regression analyses were used to examine associations between each of the predictor independent variables and dietary outcome and nutrition knowledge pre-score dependent variables of the sample population. The significance level was set at 0.05.

Results

Characteristics of the study sample are shown in Table 11. 777 students completed a pre course survey. Seven hundred and thirty-six (736) students completed the presurvey gender and age questions. Ages of students ranged from 17 to 39 years and the average age was 19.5 years. A little more than 72% of students indicated they were female and almost 27% indicated they were male. The most frequently cited reasons students reported for taking the course was that they were "interested in learning how to eat healthier" (59.2%), that the course "just seemed interesting" (56.2%), and "I'm a foodie" (29.9%). The course was required for 38.5% of students.

Table 11. Characteristics of participants (n=777)

Characteristics	n (%)
Sex[a]	
Female	532 (72.3%)
Male	196 (26.6%)
Other	8 (1.0%)
Age[b]	
17-18 years	248 (33.7%)
19-20 years	315 (42.8%)
21-25 years	168 (22.8%)
26-39 years	5 (0.7%)
Motivation for taking the course[c]	
Interested in learning how to eat healthier	460 (59.2%)
Just seemed interesting	437 (56.2%)
I'm a foodie	232 (29.9%)
I am concerned about a family member (w/nutrition-related disease)	36 (4.6%)
My friends are taking the class	8 (1.0%)
Required (nutritional science)	39 (5.0%)
Required (dietetics)	34 (4.4%)
Required (food science)	10 (1.3%)
Required (other than nutrition/dietetics)	216 (27.8%)
Other reason	143 (18.4%)

[a] Total number who selected either male, female, other or declined to answer the presurvey gender question, n=736

[b] Total number of respondents who entered an age in the presurvey age question, n = 736

[c] Respondents could select more than one response

Summary statistics for average daily dietary intakes as predicted by Dietary Screener Questionnaire (DSQ) responses are shown in Table 12. On average, college students consumed lower than recommended levels of whole grains, fiber, fruits, vegetables, and dairy. They consumed on average more total added sugars than recommended intake levels. Whole grain mean intake for females and males were below the 3 to 5 oz equivalents/day recommended intake levels at 0.6 and 0.7 oz equivalents/day, respectively. For fruit and vegetables combined, mean intakes for females and males were below the daily 4-6.5 cup equivalents/day recommended intake levels at 2.3 and 2.7 cup equivalents/day, respectively. Female and male intakes were below the cup equivalents/day recommended intake levels for vegetables alone (1.3, 1.6, respectively) and fruits alone (0.9, 1.1, respectively). In addition, daily mean intake cup equivalents/day of dairy for females and males were below the recommended 3 cup equivalents/day; 1.4, 1.9, respectively.

Table 12. Mean daily dietary intakes for young adults before taking an introductory nutrition course

Dietary Intake Variable Per Day	n	Mean Std Dev Total sample	n	Mean Std Dev Female	n	Mean Std Dev Male	USDA daily goals Female[a]	USDA daily goals Male[b]
Whole grains (ounce equivalents)	723	0.63 ± 0.29	531	0.60 ± 0.26	189	0.71 ± 0.36	3-4 oz-equiv	4-5 oz-equiv
Fiber (grams(g))	706	15.46 ± 3.06	516	14.68 ± 2.65	187	17.58 ± 3.14	28 g	34 g
Fruits and vegetables including legumes and excluding French fries (cup equivalents)	717	2.38 ± 0.73	523	2.28 ± 0.66	191	2.68 ± 0.84	4-5 cup-equiv	5-6.5 cup-equiv
Vegetables including legumes and excluding French fries (cup equivalents)	720	$1.41 + 0.38$	526	1.34 ± 0.35	191	1.56 ± 0.41	2.5-3 cup-equiv	3-4 cup-equiv
Fruits (cup equivalents)	723	0.96 ± 0.42	528	0.91 ± 0.35	192	1.10 ± 0.53	1.5-2 oz-equiv	2-2.5 oz-equiv
Total added sugars (teaspoon equivalents)	721	14.65 ± 4.01	526	14.16 ± 3.45	192	15.97 ± 5.04	12 tsp[c]	12 tsp[c]
Added sugars from sugar-sweetened beverages (teaspoon equivalents)	724	6.45 ± 3.22	529	6.12 ± 2.96	192	7.39 ± 3.70		
Calcium (milligrams (mg))	706	928.80 ± 184.43	516	861.95 ± 116.37	187	1113.38 ± 210.70	1000 mg	1000 mg
Dairy (cup equivalents)	720	1.49 ± 0.53	526	1.36 ± 0.38	191	1.87 ± 0.67	3 cup-equiv	3 cup-equiv

[a] Female daily recommended intake levels, 19-30 years of age. (Dietary Guidelines for Americans, 2020-2025)

[b] Male daily recommended intake levels, 19-30 years of age. (Dietary Guidelines for Americans, 2020-2025)

[c] Added sugars—Less than 10 percent of calories per day starting at age 2. For 2000 calorie diet 10% of calories equals 12 teaspoons.

Table 13 presents mean nutrition knowledge pre-scores and the frequency and percentage of students reporting that they agree with the four National Health Interview Survey statements: 1) There are plenty of healthy foods that taste good, 2) It is easy to eat a healthy diet, 3) I get encouragement from my family or friends to eat more healthy food, 4) In general, healthy foods cost more than other kinds of food. The mean nutrition knowledge pre-score was 28.7 ± 8.97. Over 95% of the sample agreed with the statement that "there are plenty of healthy foods that taste good," approximately 60% of the sample agreed with the statement, "it is easy to eat a healthy diet" over 74% of the sample agreed with the statement, "I get encouragement from my family or friends to eat more healthy food," and approximately 82% of the sample agreed with the statement, "in general, healthy foods cost more than other kinds of foods."

Table 13. Mean nutrition knowledge pre-score, frequency and perceived taste, ease, encouragement, and cost of healthy food

	N	**Mean (Std Dev) or Frequency (% agree with statement)**
Nutrition knowledge pre-score (Range 1-54)	736	28.7 (8.97)
There are plenty of healthy foods that taste good	737	703 (95.4%)
It is easy to eat a healthy diet	737	449 (60.1%)
I get encouragement from my family or friends to eat more healthy food	736	551 (74.9%)
In general, healthy foods cost more than other kinds of foods	736	604 (82.1%)

Multivariate linear regression analyses were used to determine relationships between predictor and outcome variables after controlling for age, gender, nutrition knowledge pre-score, perceived ease, taste, encouragement, and cost of healthy foods. The results are presented in Tables 14, 15, and 16. Male gender was positively associated with all outcome variables: combined fruit/vegetables cup equivalents/day, vegetables cup equivalents/day, fruits cup equivalents/day, fiber grams/day, total added sugars teaspoon equivalents/day, added sugars from sugar sweetened beverages teaspoon equivalents/day, calcium milligrams/day, and dairy

cup equivalents/day. For example, compared to females, males had on average 0.44 greater higher combined fruit and vegetables cup equivalents/day.

Age was only negatively associated with fruit cup equivalents/day. Nutrition knowledge pre-score was positively associated with combined fruit/vegetables cup equivalents/day, vegetables cup equivalents/day, fruits cup equivalents/day, fiber grams/day, calcium milligrams/day and negatively associated with added sugars from sugar sweetened beverages teaspoon equivalents/day. For example, for every one-point increase in nutrition knowledge pre-score, combined fruit/vegetables cup equivalents/day increased by 0.02 cup equivalents/day. Nutrition knowledge pre-score was not associated with total added sugars teaspoon equivalents/day and dairy cup equivalents/day.

Perceived taste of healthy foods was not associated with any outcome variables. However, perceived ease of eating a healthy diet was positively associated with all variables except for calcium milligrams/day and dairy cup equivalents/day. For example, compared to students' who disagreed, students who agreed that eating a healthy diet is easy had on average 0.23 greater higher combined fruit/vegetables cup equivalents/day.

Perceived cost healthy foods was negatively associated with all variables except for total added sugars teaspoon equivalents/day, calcium milligrams/day, and dairy cup equivalents/day., Compared to students' who disagreed, students who agreed that healthy foods costs more than other kinds of foods had on average 0.23 greater lower combined fruit/vegetables cup equivalents/day.

Lastly, perceived encouragement from family or friends to eat more healthy foods was positively associated with combined fruit/vegetables cup equivalents/day and vegetables cup equivalents/day. Compared to students' who disagreed, students who agreed that they received encouragement from their family and friends to eat more healthy food had on average 0.14 greater higher combined fruit/vegetables cup equivalents/day.

Table 14. Associations between age, gender, and agreement with perceived taste, ease, encouragement, and cost of healthy food and intakes of fruits, vegetables, and fiber

	Fruits/vegetables, legumes, no FF[a] (cup equivalents/day)			Vegetables, legumes, no FF[a] (cup equivalents/day)			Fruits (cup equivalents/day)			Fiber (grams/day)		
	Beta coefficient	*SE*	p-value	Beta coefficient	*SE*	p-value	Beta coefficient	*SE*	p-value	Beta coefficient	*SE*	p-value
Age	-0.02	0.14	.13	-0.00	0.01	.97	-0.02	0.01	0.02	-0.11	0.058	0.06
Gender												
Male	0.44	0.06	<.00	0.23	0.03	<.00	0.21	0.03	<.00	3.01	0.23	<.00
Female	Reference			Reference			Reference			Reference		
Nutrition knowledge pre-score	0.02	0.00	<.00	0.01	0.00	<.00	0.01	0.00	<.00	0.08	0.01	<.00
There are plenty of healthy foods that taste good.												
Agree	0.23	0.13	0.06	0.09	0.06	0.17	0.10	0.07	0.17	0.31	0.51	0.54
Disagree	Reference			Reference			Reference			Reference		

65

Table 14. (cont'd)

It is easy to eat a healthy diet												
Agree	0.23	0.05	<.00	0.10	0.03	0.00	0.11	0.03	0.00	0.78	0.21	0.00
Disagree	Reference			Reference			Reference			Reference		
I get encouragement from my family or friends to eat more healthy food												
Agree	0.14	0.06	0.02	0.10	0.03	.00	0.03	0.03	0.31	0.38	0.23	0.10
Disagree	Reference			Reference			Reference			Reference		
In general, healthy foods cost more than other kinds of foods												
Agree	-0.23	0.07	0.00	-0.13	0.03	.00	-0.09	0.04	0.03	-1.14	0.26	<.00
Disagree	Reference											

Table 14 (cont'd)

R-squared	0.198	0.203	0.116	0.287
Adjusted R-squared	0.190	0.195	0.107	0.280
N	711	714	717	700

Note. [a]French fries (FF), Standard Error (SE)

Table 15. Associations between age, gender, and perceived taste, ease, encouragement, and cost of healthy food and intakes of total added sugars, added sugars from SSB, calcium, and dairy

	Dietary Intake Group											
	Total added sugars (tsp equivalents/day)			Added sugars from sugar-sweetened beverages (tsp equivalents/day)			Calcium (mg/per day)			Dairy (cup equivalents/ day)		
	Beta coefficient	SE	p-value	Beta coefficient	SE	p-value	Beta coefficient	SE	p-value	Beta coefficient	SE	p-value
Age	-0.05	.08	0.53	0.05	0.068	0.45	-4.08	3.26	0.21	-0.02	0.01	0.10
Gender												
Male	1.90	.33	<.00	1.21	0.27	<.00	255.24	12.78	<.00	0.52	0.04	<.00
Female	Reference			Reference			Reference			Reference		
Nutrition knowledge pre-score	-0.01	.02	0.44	-0.03	0.01	0.02	1.49	0.64	0.02	-0.00	0.00	0.89
There are plenty of healthy foods that taste good.	-0.36	.75	0.63	0.14	0.58	0.81	-20.95	28.82	0.47	-0.10	0.09	0.28
Agree												
Disagree	Reference			Reference			Reference			Reference		

68

Table 15 (cont'd)

It is easy to eat a healthy diet												
Agree	-1.23	.31	<.00	-1.05	0.25	<.00	7.03	12.02	0.56	-0.02	0.039	0.58
Disagree	Reference			Reference			Reference			Reference		
I get encouragement from my family or friends to eat more healthy food												
Agree	-0.50	.34	0.14	-0.24	0.27	0.37	8.25	13.02	0.53	0.02	0.04	0.69
Disagree	Reference			Reference			Reference			Reference		
In general, healthy foods cost more than other kinds of foods												
Agree	0.41	.38	0.29	0.62	0.31	0.04	-5.07	14.62	0.73	0.03	0.05	0.46
Disagree	Reference			Reference			Reference			Reference		
R-squared	0.073			0.077			0.370			0.184		
Adjusted R-squared	0.063			0.068			0.364			0.176		
N	715			718			700			714		

Note. Standard Error (SE)

Table 16 summarizes the results of multivariate regression analysis conducted to examine the relationship between predictor variables and nutrition knowledge at the beginning of the course after controlling for age, gender, nutrition knowledge pre-score, perceived ease, taste, encouragement, and cost of healthy foods. Perceived taste of healthy foods and ease of eating healthy foods were associated with students' nutrition knowledge scores, while age, gender, and perceived cost of healthy foods were not. Students who agreed that there are plenty of healthy foods that taste good and it is easy to eat a healthy diet had higher average nutrition knowledge pre-scores of 3.29 points and 2.29 points, respectively compared to students who disagreed with those statements.

Table 16. Associations between age, gender, and perceived taste, ease, encouragement and cost of healthy food, and nutrition knowledge pre-score (n=723)

	Beta coefficient	*SE*	**p-value**
Age	-0.03	0.19	0.88
Gender			
Male	-0.88	0.76	0.25
Female	Reference		
There are plenty of healthy foods that taste good.			
Agree	3.29	1.65	0.05
Disagree	Reference		
It is easy to eat a healthy diet			
Agree	2.29	0.71	0.00
Disagree	Reference		
I get encouragement from my family or friends to eat more healthy food			
Agree	-1.56	0.77	0.04
Disagree	Reference		
In general, healthy foods cost more than other kinds of foods			
Agree	-1.37	0.87	0.11

Table 16 (cont'd)

Disagree	Reference
R-squared	0.035
Adjusted R-squared	0.027
No. observations	723

Standard Error (SE)
Predictor variables: Age; Gender; Agreement with statements: There are plenty of healthy foods that taste good; It is easy to eat a healthy diet; I get encouragement from my family or friends to eat more healthy food; and In general, healthy foods cost more than other kinds of foods
Outcome variable: Nutrition knowledge pre-score

Discussion

This study adds to the surprisingly limited research characterizing dietary patterns and intake levels of young adults.[158] The present study is from a large cohort of young adults enrolled in an asynchronous introductory human nutrition course at a midwestern University. The study assessed student dietary intake as well as identified characteristics associated with nutrition knowledge and consumption of healthy foods. Our findings indicate that mean dietary intake among the college students in our sample was below the recommended levels for whole grains, fiber, fruits and vegetables, and dairy, close to the recommended amounts of calcium intake (with males exceeding recommendation levels), and greater than the recommended number of teaspoons for total added sugar for a 2000 calorie diet (i.e., 12 tsp).

Our findings are consistent with previous research reporting that young adults do not meet recommended intake levels of important food groups.[14,84-87,91,153,159] These findings are important because the dietary patterns established in young adulthood set the stage for future chronic disease development. In fact, the dietary intake of young adults of child-bearing age can impact intergenerational chronic disease risk through epigenetic changes; such as through the methylation of gametes and changes in spermatozoan nucleus.[160]

In our study, dietary outcome measures differed by gender, with males having higher mean intakes of fruits, vegetables, fiber, calcium, dairy, total added sugars, and added sugars from SSBs, while controlling for age, nutrition knowledge pre-score, perceived ease, taste, encouragement, and cost of healthy foods. These findings are likely due to males, in general, being more likely to consume greater quantities of food than females; it is important to note that the DSQ does not account for caloric intake. This finding is interesting given that some

investigators have reported females consume more fruits and vegetables, compared to males.[84,85,161] This may indicate that among our sample population, males may not be representative of the general population. It may also indicate that if we had adjusted for calorie intake, average intakes for females may have been higher than males.

Our study also identifies characteristics associated with intakes of healthy foods, which may provide insight to improve the design of nutrition interventions with young adults. We found that nutrition knowledge was positively associated with all dietary outcome variables except for total added sugars and dairy. Previous literature supports a relationship between nutrition knowledge and healthier eating habits,[162-164] as well as the fact that a lack of nutrition knowledge serves as a barrier to healthy eating.[52-54,61,70,71]

We also found that agreement with perceived ease, cost, encouragement, but not taste of healthy foods were associated with dietary intake while controlling for age, gender, and nutrition knowledge. For example, we found that agreement with perceived ease of eating a healthy diet was associated with all dietary intake variables except for calcium and dairy. This finding is similar to other research reporting that convenience and food preparation time can be facilitators to healthy eating.[49,51-57,63-67,75] We also found that students agreeing that healthy foods cost more? had lower intakes of combined fruit/vegetables, vegetables cup, fruits , fiber, and higher intakes of added sugars from sugar sweetened beverages compared to students who disagreed. This finding aligns with research reporting cost of healthier food as an important barrier to healthy eating.[49,51-54,59,62,75 55-57,60,61] In addition, we found that perceived encouragement from family or friends was associated with combined fruit/vegetables and vegetables; which also appears in the literature as facilitator.[62,73] Lastly, despite perceived taste of healthy foods being cited as a barrier to healthy eating in many studies, there were no associations between perceived taste and dietary intake.[50,53,57,60,67,74,75]

This study's strengths include its large sample size and use of validated questionnaires. Study limitations to consider when interpreting results are that this sample was not randomized and individuals self-selected into the course. As a result, the sample may be more likely to practice healthy eating behaviors compared to the general population and results may not be generalizable to all young adults. Another limitation may be the survey length. The questionnaire took on average 20 minutes to complete, which may have resulted in respondent

survey fatigue; thus, impacting responses. Lastly, our study utilized cross-sectional data to report associations and causality cannot be determined.

Conclusions

In summary, this cross-sectional study assessed student dietary intake from a large sample of young adults enrolled in a midwestern University asynchronous online introductory nutrition course and found that dietary intakes of young adults do not meet U.S. dietary recommendations for whole grains, fruits, vegetables, dairy, and added sugars. Perceived taste and ease of eating healthy foods were associated with greater higher nutrition knowledge scores. Nutrition knowledge, perceived ease of eating, and cost of healthy foods were associated with higher intakes of combined fruit/vegetables , vegetables, fruits, and fiber. Given the current trends both in the U.S. and globally of chronic disease; low-cost, scalable, and effective nutrition interventions must be developed. Our findings suggest that dietary interventions might benefit from including strategies aimed at increasing general nutrition knowledge, increasing perceived ease of eating healthy foods, encouraging lower cost affordable healthy foods, and increasing family and/or friend support of eating healthy foods.

Chapter 5 – Students Acting as Agents of Change in An Online University Nutrition Course

Introduction

The US Dietary Guidelines encourage shifting dietary patterns across all age groups to include greater amounts of fruits, vegetables, whole grains, legumes, and lower amounts of added sugar.[1] Americans adults do not meet the U.S. Dietary Guidelines recommendations and consume too many calories, saturated fat, sodium, added sugars and too few fruit, vegetables, whole grains, nuts, seeds, and legumes.[24] Average non-starchy vegetable intake levels are below the $\geq$ 2.5 daily cup recommended levels across racial and ethnic groups except for white non-Hispanic females.[22] Average fruit consumption is below the $\geq$ 2 cups/day of recommended intake levels, with average fruit consumption among adults ranging from 1 to 1.6 servings per day. Whole grains are also underconsumed, with fewer than 10% of US adults meeting whole grain recommendations of consuming 3 or more servings per day.[22] Only approximately 5% of US adults consume legumes on any given day and 18-25 year olds were least likely to consume legumes.[26] Only 25% of non-Hispanic whites, 16% non-Hispanic blacks, and 12.5% Mexican Americans met the weekly nut and seed intake recommendation of 4 or more servings per week.[22]

Young adults are especially low in consumption of important food groups. In an analysis of Behavioral Risk Factor Surveillance System data, Lee-Kwan et al,[165] reported that young adults, ages 18–30 years, compared to older adult age groups, had the lowest percentage of individuals meeting fruit and vegetable intake recommendations. In addition, young adults in 41 states, as compared to older age groups, were least likely to meet vegetable intake recommendations and in 18 states least likely to meet fruit intake recommendation.[166] Moreover, the American College Health Association National College Health Assessment reported that only 4.1% of college aged adults consumed five or more servings of fruits and vegetables daily.[167]

Intervening within the university setting may be a promising approach to reach young adults because approximately 19 million adults between the ages of 19-25 years of age are enrolled in a college or university annually.[9] University nutrition courses may be an important avenue to reach young adults. Surprisingly however, we identified only five interventions in the literature where a semester-long university course was studied as a dietary change intervention.[11-16,95] While course content, dietary assessment tools used, outcome measures, and

results varied across the interventions, four of the five interventions reported positive outcomes across many dietary measures. For example Matvienko et al[11] reported that there was a significant difference between the university course group and the control group at the end the intervention by more than 500kcals/day (control group 2244.3; intervention group 1729.8 Hekler et al[95] reported that there were significant changes from the beginning of the course to the end of the course in mean healthful diet score and number of vegetables servings per week after students took a food and society course. Hager et al[13] reported that compared to intakes before taking the course, vegetable, whole grain cereal and intake significantly increased by 4%, 8%, and 11%, respectively. [13] An intervention reported by Ha et al.[14-16] found significant increases in total average vegetables, total fruit, and fresh fruits and vegetables after students completed a introductory nutrition course.[14]

An "agent of change" intervention approach is one where an individual has an instrumental role in the intervention and provides behavior/environmental change information, support, and/or reinforcements. The use of "agents of change" or "change agents" within interventions has been found in various disciplines including nutrition. In a systematic review of obesity e-health prevention interventions, investigators identified eight studies where parents acted as agents of change[168-175] for example, learning about goal-setting, receiving monthly newsletters, and receiving voice messages to enhance child parental support of dietary changes. Four of the eight studies reported positive changes in at least one of the following: combined fruit and vegetable intake, nutrition knowedge, caloric intake, energy intake from fat, and reduction in calorie dense foods. In another study, employees were trained to deliver 5-A-Day messaging to co-workers which significantly increased 5-A-Day awareness, knowledge, and attitudes among the employees who received the messages.[176] The national Black Barbershop Health Outreach Program (BBHOP) has trained African American barbers in 20 US cities to screen and raise community awareness around cardiovascular diseases. Since its creation, BBHOP has screened more than 7000 African American men.[105]

Children can also act as agents of change. In an article by Kelly et al,[111] 15 studies were identified where children acted as agents of change with parents;[103,104,112-124] .[104] In this group of studies, children acting as agents of change shared information to encourage cancer screening, prevention of infectious diseases, and blood pressure control. In the one agent of change healthy eating intervention reported, DeSmet et al[104] enrolled 100 child-parent dyads in a three month

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intervention, where children participated in a online 10- episode videogame to increase the frequency of at-home fruit and vegetable asking behaviors. At-home fruit and vegetable asking behavior score and availability significantly increased post intervention compared to baseline.

University students have served as agents of change or peer educators on college campuses in a variety of roles such as to encourage less alcohol and tobacco use, establish healthy relationships, and seek mental health services, although, to our knowledge, not nutrition behaviors.[109] Collins et al[108] report that there is strong evidence in the literature showing that university students can be effective at teaching, reinforcing, and modeling behaviors among their peers.

The present study worked with college students enrolled in an introductory human nutrition course to act as agents of change for family members and/or friends to encourage consumption of healthy foods. As far as we know, no previous studies have asked college-aged students to act as agents of change to convey healthy eating information to family members or friends; and no studies have evaluated the diets of the agents of change. The objectives of this study were to determine whether students taking an introductory nutrition course with agent of change (AOC) assignments 1) increased their nutrition knowledge and improved their diets over the course of the semester and 2) made greater improvements in their nutrition knowledge and diets compared to college students taking a course without AOC assignments. In addition, we aimed to determine whether students acting as agents of change displayed more perceived improvements in healthy eating knowledge, familiarity, skills, confidence, motivation, and healthy food consumption over the course of the semester compared to students who did not act as agents of change in the same university course.

Methods

This study worked with two cohorts of college students enrolled in Fall semester (14-week) asynchronous online introductory nutrition classes. The first cohort of students completed the course during the Fall of 2020 without an agent of change assignment (2020 No AOC Cohort) and the second cohort of students completed the course in the Fall of 2021 with an agent of change assignment (2021 AOC Cohort). Both courses took place during the Covid-19 global pandemic, however, students were in different locations when they took the classes. Most students taking the class during the Fall 2020 semester were living away from campus and/or at

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their parents' home. Students returned to campus for the Fall 2021 semester and most students were living on campus in dormitories or locally in off-campus housing.

Both courses had the same instructor and covered the same content with recorded lectures on topics including nutrition recommendations, regulations, labeling, digestion, gut health, digestive disorders, alcohol, carbohydrates, diabetes, lipids, cardiovascular disease, protein, nutrition and sustainability, food insecurity, vitamins, water, minerals, energy balance, obesity, healthy body image, dieting eating disorders, physical activity, sports nutrition, and nutrition for pregnancy, infancy and children. Both courses also included the same assignments including six food-based activities/online discussion assignments. For each activity/discussion, students were asked to read and/or view materials about a nutrition topic, try healthy foods and participate in online discussion forums where they described their insights and reactions through a series of questions.

The 2021 class added six agent of change activities to the six food-based activities/online discussion assignments. The goal of the agent of change video activities were for students to encourage their family and friends to increase intakes of whole plant foods. Students were _required_ to create six video presentations (using an existing template presentation) of what they had learned and include their videos in their discussion posts. The six agent of change video activities were designed to encourage intake of: 1) whole plant foods, 2) green leafy vegetables, 3) whole grains, 4) legumes, 5) dark orange/yellow/red fruit and vegetables, and 6) nuts and seeds. After videos were created, students were encouraged _but not required_ to share their videos with family members and/or friends. Thus the 2021 AOC Cohort was split into two further groups: 2021 AOC-share group, who reported sharing videos with at least one friend or family member, and 2021 AOC-no share group, who reported that they did not share videos with anyone.

Data collection and measures

Students in both classes were asked to complete pre, mid, and post questionnaires at the beginning, middle, and end of the semesters, respectively. The pre survey for the 2020 no AOC Cohort started on the first day of classes and was open for 16 days. The pre survey for the 2021 AOC Cohort also started on the first day of classes and was open for 29 days. The post survey for the 2020 no AOC Cohort and the 2021 AOC Cohort were administered during the last three

weeks of the semester and open for 21 days. For both Cohorts, the mid-term course evaluation survey was administered during a four-week period and open for 27 days. The pre and post questionnaires took about 20 minutes and the mid survey questionnaires took about 10 minutes to complete.

The pre and post questionnaires were comprised of questions from three validated questionnaires: Jones Nutrition Knowledge (JNN) questionnaire,[154] Dietary Screener Questionnaire (DSQ),[155] and the 1992 National Health Interview Survey.[156] The Jones Nutrition Knowledge questionnaire contains 63 questions (22 dietary guideline questions, 26 nutrition knowledge questions, and 15 nutrition related disease questions).The Dietary Screener Questionnaire (DSQ) was developed by the National Cancer Institute and is a short dietary assessment instrument containing 26 items and provides intake estimates for fruits and vegetables, dairy/calcium, added sugars, and whole grains/fiber.[155]

For both cohorts, students were asked to report their gender as male, female, or "additional gender category," and age in years. Students were also asked to share their motivation for taking the course by selecting from the following responses: It is required for my major, which is nutritional science; which is dietetics; which is food science; which is a major other than nutrition/dietetics; I am interested in learning about how I can eat healthier; I am concerned about a family member who is sick with a nutrition-related disease; It just seemed like an interesting class; My friends are taking the class; I'm a foodie; and Other (please specify). For the analysis, a new motivation variable was created which coded the students either as being required or not required to enroll in the course. Those coded as "required" selected one of the following answer choices: It is required for my major, which is nutritional science; which is dietetics; which is food science; which is a major other than nutrition/dietetics. Students coded as "not required" selected an answer choice other than one of the "required" answer options.

The outcome variables for this study consisted of the nutrition knowledge score and dietary intake of whole grains (ounce equivalents), fiber (g), combined fruits and vegetables including legumes and excluding French fries (cup equivalents), vegetables including legumes and excluding French fries (cup equivalents), fruits (cup equivalents), dairy (cup equivalents), calcium (mg), total added sugars (tsp equivalents), and added sugars from sugar-sweetened beverages (tsp equivalents). The nutrition knowledge score was calculated for each student by tabulating the total number of correctly answered nutrition knowledge questions and had a

possible score range of 0-60. The DSQ dietary intake variables were calculated using the National Cancer Institute's publicly available SAS PROC Reg procedure for converting survey responses to the estimates of individual dietary intakes.[157]

For the 2021 AOC Cohort only, additional outcome variables consisted of whether students shared videos with friends and/or family members, and their perceived changes in knowledge, familiarity, preparation ability, skills, confidence, motivation, and consumption of unprocessed whole plants foods, green leafy vegetables, whole grains, legumes, dark orange/yellow/red fruit and vegetables, and raw nuts and seeds. Eleven questions about the agent of change video activities were included in the 2021 AOC Cohort mid-semester survey. Students were asked if they shared any videos, with whom they shared videos, how many people were videos shared with, feedback received, reasons for not sharing videos, and perceived benefits from completing the agent of change video activities.

To capture perceived dietary related changes, questions were added to the 2021 AOC Cohort post survey and asked students to rate their agreement/disagreement with six statements listed under seven major group statements using a five-point Likert scale (strongly agree ("5"), agree ("4"), neither agree nor disagree ("3"), disagree ("2"), strongly disagree ("1"), and does not apply ("0"). All seven major group statements were prefaced with the following question: "In comparison to before you completed the video assignment, after completing the assignments and videos, for each of the following questions and each statement listed, select the answer that best indicates how much you personally agree or disagree with that statement." The seven major group statements under the above question included the following statements:

   1. I know more about the health benefits of eating…;

   2. I am more familiar with…;

   3. I am better able to prepare or cook…;

   4. I have more skills to eat…;

   5. I have more confidence in my ability to eat…;

   6. I am more motivated to eat…; and

   7. I am eating more….

Under each of the above seven group statements respondents were asked to agree or disagree using the five-point Likert scale with the following six food category sub-statements:

      1. unprocessed whole plants foods,

2. green leafy vegetables, like spinach, romaine lettuce, and kale,

3. whole grains, like whole wheat bread, oatmeal, and brown rice,

4. legumes like chickpeas, black beans, and peanuts,

5. dark orange/yellow/red fruit and vegetables, like red peppers, apricots, and sweet
potatoes, and

6. raw nuts and seeds, like almonds, walnuts, and sunflower seeds.

A total group statement score for each of the seven major group statements was generated by summing the responses for all statements within each of the seven group statement categories. For example, for the statement "I know more about the health benefits of eating…a student who selected "strongly agree" received a score of "5," whereas a student who selected "strongly disagree" received a score of "1" for that statement. If a student answered "strongly agree" for all six food category sub-statements then the student received a total score of "30" for that one major group category (5 statements each with a score of "5" x 6 sub category statements = 30).

The 2020 no-AOC Cohort surveys were administered in Survey Monkey (https://www.surveymonkey.com) The 2021 AOC Cohort surveys were administered in Qualtrics (https://www.qualtrics.com). This study was approved by the Michigan State University Institutional Review Board.

Statistical Analysis

Data was de-identified prior to analysis. SAS studio 3.81 (SAS Institute Inc) was utilized for all analyses. Descriptive statistics, including frequencies, means and standard deviations were calculated for all variables of interest. Paired and two-sample t-tests, and multiple linear regression were utilized to evaluate the differences between nutrition knowledge and dietary outcome variables among students in the 2020 no-AOC Cohort versus 2021 AOC Cohort, as well as between the two groups of students within the 2021 AOC Cohort who shared videos with their friends and/or family members (2021 AOC-shared Cohort), and students who did not share videos (2021 AOC-no shared Cohort). One-way ANOVA, Bonferroni correction, and multiple linear regression were performed to determine if sharing videos had a measurable effect on the dietary outcome variables while controlling for age, nutrition knowledge pre-score, gender, and motivation for taking the course. In addition, multiple linear regression was performed to evaluate the relationship between sharing or not sharing videos on student perceived changes in

knowledge, familiarity, preparation ability, skills, confidence, and motivation to eat healthier foods. For all analyses, the significance level was set at 0.05.

Results

Table 17 displays gender, age, and motivation for enrolling in the course for all students (2020 no-AOC Cohort , 2021 AOC Cohort, 2021 AOC-share group, and 2021 AOC-no share group). For both cohorts, approximately 70% were female, , and average age was 19.5 years. Between group comparisons were made to compare the cohorts' baseline characteristics. Pearson chi-square tests found that there was a significantly lower percentage of females in the 2020 no-AOC Cohort than the 2021 AOC Cohort (X^2 (1, n=1665) = 4.9, p = 0.028). There were no significant differences for gender between the 2021 AOC-share Cohort and the 2021 AOC-no share Cohort, X^2 (1, n= 617) = 3.4, p = .063). There were no significant differences at baseline in average age for any of the groups.

For both cohorts, the most frequently reported motivations for enrolling in the course was "I am interested in learning about how I can eat healthier," followed by "It just seemed like an interesting class," "It is required for my major, which is a major other than nutrition/dietetics," and "I'm a foodie."

Table 17. Sample characteristics all groups

	2020 no-AOC Cohort (*n=916*)	2021 AOC Cohort (*n=777*)	2021 AOC-share group (*n=355*)	2021 AOC-no share (*n=283*)
Gender[a]				
Female	621 (67.8%)	549 (70.7%)	261 (73.5%)	196 (69.3%)
Male	292 (31.9%)	203 (26.1%)	78 (22.0%)	82 (29.0%)
Other	3 (0.3%)	25 (3.2%)	16 (4.5%)	5 (1.8%)
Age[b]				
17-18 years	278 (31.4%)	248 (33.7%)	118 (34.8%)	89 (32.6%)
19-20 years	426 (48.2%)	315 (42.8%)	137 (40.4%	129 (47.3%)
21-25 years	163 (18.4%)	168 (22.8%)	82 (24.2%	52 (19.0%)
26-39 years	14 (1.8%)	5 (0.7%)	2 (0.6%)	3 (1.1%)
40-44 years	1 (0.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Motivation for taking the course[c]				
I am interested in learning about how I can eat healthier	592 (64.6%)	460 (59.2%)	231 (65.1%)	160 (56.5%)
Just seemed like an interesting class	552 (60.3%)	437 (56.2%)	201 (56.6%)	162 (57.2%)
I'm a foodie	277 (30.2%)	232 (29.9%)	114 (32.1%)	81 (28.6%)
I am concerned about a family member who is sick with a nutrition-related disease	56 (6.1%)	36 (4.6%)	16 (4.5%)	12 (4.2%)
Required (other than nutrition/dietetics)	293 (32.0%)	216 (27.8%)	84 (23.7%)	92 (32.5%)
Required (nutritional science)	40 (4.4%)	39 (5.0%)	24 (6.8%)	8 (2.8%)
Required (dietetics)	20 (2.2%)	34 (4.4%)	22 (6.2%)	10 (3.5%)

Table 17 (cont'd)

Required (food science)	17 (1.9%)	10 (1.3%)	6 (1.7%)	3 (1.1%)
My friends are taking the class	22 (2.4%)	8 (1.0%)	3 (0.8%)	3 (1.1%)
Other reason	115 (12.6%)	143 (18.4%)	72 (20.3%)	48 (17.0%)

[a]Gender: Chi-square test results show a significant difference between genders comparing 2020 no-AOC Cohort with 2021 AOC Cohort (p=.03); comparing 2020 no-AOC Cohort with 2021 AOC-share group (p=.002); no significant differences observed between genders comparing 2020 no-AOC Cohort with 2021 AOC-no share (p=.43) and comparing 2021 AOC-share group with 2021 AOC-no share (p=.07)

[b]Age: Two sample t-test results show no significant differences between mean ages comparing 2020 no-AOC Cohort with 2021 AOC Cohort. (p = .63); and one way ANOVA results show no significant differences between mean ages comparing 2020 no-AOC Cohort, 2021 AOC-share group, and 2021 AOC-no share group. $(F_{(2,1495)}, F=.15, p= .86)$

[c]Motivation: Chi-square test results show no significant difference between students who were required to take the course compared with those who were not required to take the course when comparing 2020 no-AOC Cohort with 2021 AOC Cohort (p=.67); 2020 no-AOC Cohort with 2021 AOC share group (p=.68); 2020 no-AOC Cohort with 2021 AOC-no share group (p=.64); 2021 AOC share group with 2021 AOC-no share group (p = .95)

To compare baseline characteristics for nutrition knowledge and dietary outcome measures, t-tests and one-way ANOVA tests were performed and are presented in Table 18. The 2020 no-AOC Cohort and 2021 AOC Cohort were not statistically different for all baseline characteristics, except for pre course dairy intake (p= 0.01). One-way ANOVA tests were also performed comparing baseline means of outcome measures among 2020 no-AOC Cohort, 2021AOC-share Cohort, and 2021 AOC-no share group. All outcomes except for pre course dairy intake ($F_{(2,1447)} = 5.14$, p= .006) were non-significant indicating no differences in the means between the three groups.

Table 18. Baseline nutrition knowledge scores and dietary outcome measures

	2020 no-AOC Cohort[ab] (*n*=916)		2021 AOC Cohort[a] (*n*=777)		2021 AOC-share group[b] (*n*=355)		2021 AOC-no share group[b] (*n*=283)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Nutrition knowledge score	29.35	9.46	28.67	8.98	29.18	8.77	27.94	9.03
Whole grains (ounce equiv/day)	0.64	0.30	0.63	0.29	0.63	0.30	0.62	0.29
Fiber (grams/day)	15.42	2.75	15.46	3.06	15.47	2.96	15.58	3.19
Fruits/Veg, legumes no FF (cup equiv/day)	2.36	0.67	2.38	0.73	2.40	0.74	2.40	0.76
Vegetables, legumes no FF (cup equiv/day)	1.38	0.012	1.40	0.014	1.41	0.38	1.41	0.39
Fruits (cup equiv/day)	0.96	0.42	0.96	0.42	0.96	0.41	0.97	0.43
Dairy (cups/day)	1.57	0.021	1.49	0.02	1.45	0.45	1.53	0.56
Total added sugars (tsp equiv/day)	14.70	0.15	14.65	0.15	14.43	3.55	14.74	4.05

Results include only those less than 26 years of age.
Standard deviation (SD)
[a]Two sample t-test comparing 2020 no-AOC Cohort and 2021 AOC Cohort was performed for all outcome measures to compare means between the two groups. [b]One-way ANOVA tests performed comparing 2020 no-AOC Cohort, 2021 AOC-shared Cohort, 2021 AOC-no share group.
All two-sample t-test results were not significant, except for pre course dairy intake.

Tables 19-24 display the results to questions about sharing and perceived value of agent of change videos by students and recipients of the videos. Among the 2021 AOC Cohort, 57.7% of the students reported sharing at least one video. Approximately 17% reported sharing 1 video, 19.1% reporting sharing 2 videos, 10.3% reported sharing 3 videos, 6.3% reported sharing 4 videos, and 4.9% reported sharing 5 videos (Table 19). When asked how many people students distributed the videos to, 45.0% of students reported distributing between 1 and 2 videos, 9.2% distributed videos to between 3-5 people, and 1.2% distributed videos to between 6 and 20 people (Table 20). Over 52% of students reported distributing videos to a family or relative and 14.3% distributed videos to either a friend, acquaintance, or co-worker (Table 21). Students shared the videos primarily through text messages (36.8%) and email (14.0%) and only 0.6% shared videos through Instagram or other social media (Table 22).

Approximately 75% of students reported receiving positive feedback from the person receiving the video, 0.8% reported receiving negative feedback, and 24.6% reported receiving neutral feedback (Table 23). When asked why students did not share videos, 19.5% indicated that they felt silly/embarrassed, 17.8% did not think anyone would be interested in the videos, 14.3% forgot to share videos, 11.6% were not interested in sharing videos, and 2.9% did not think their videos were high quality (Table 24). Lastly, 27.9% students reported that the agent of change video assignment was not at all helpful for learning and intellectual growth, 32.8% felt the videos were slightly or moderately helpful for learning and intellectual growth and 15.7% reported that the videos were solidly or very helpful for learning and intellectual growth (Table 25).

Table 19. Number of agent of change videos shared by students (n=651*)

	2021 AOC Cohort	
Number of videos shared	**Frequency**	**Percent**
0	275	42.3%
1	111	17.1%
2	124	19.1%
3	67	10.3%
4	41	6.3%
5	32	4.9%
Total	650	100%

*Number of respondents who responded to the mid-semester survey. 650 respondents answered the question, "How many videos have you shared?" Answer choices included "0, 1, 2, 3, 4, 5."

Table 20. Number of people students reported sending agent of change videos to (n=651*)

Number of people sent videos to	**Frequency**	**%**
0	289	44.5%
1-2	292	45.0%
3-5	60	9.2%
6-10	6	.9%
10-15	0	.0%
15-20	2	.3%
20+	0	.0%
Total	649	100%

*Number of respondents who responded to the mid-semester survey. 649 respondents answered the question, "To how many people did you send the video(s)?"

Table 21. Who received agent of change videos (n=651*)

Person who received video	**Frequency**	**%**
Does not apply, I did not share videos	289	32.1%
Friend	117	13.0%
Acquaintance	11	1.2%
Parent/guardian	292	32.4%
Sibling	97	10.8%
Grandparent	49	5.4%
Aunt/Uncle	17	1.9%
Cousin	11	1.2%
Other family	6	.7%
Co-worker	1	.1%
Other	11	1.2%
Total	901	100%

*Number of respondents who responded to the mid-semester survey. 649 respondents answered the question, "Who did you share the video(s) with? Mark all that apply."

Table 22. How agent of change videos were shared by students (n=651*)

How shared videos	Frequency	%
Does not apply, I did not share videos	280	43.3%
Text	238	36.8%
Email	90	13.9%
Instagram/other social media	4	0.6%
Other	34	5.3%
Total	646	100%

*Number of respondents who responded to the mid-semester survey. 646 respondents answered the question, "How did you share the video(s)?"

Table 23. Feedback received by students after sharing agent of change video(s) (n=366)

Answer	Count	%
Positive feedback	273	74.6%
Negative feedback	3	0.8%
Neutral feedback, I didn't get any response or reaction, or	90	24.6%
Total	366	100%

Responses to the question, "What feedback did you receive from the person(s) you sent your videos to?"

Table 24. Why agent of change videos were not shared (n=651)

Answer	Count	%
Does not apply, I shared all of the videos	179	29.2%
I wasn't interested	71	11.6%
I didn't think anyone would be interested in the videos	109	17.8%
I forgot	88	14.3%
My videos were not high quality	18	2.9%
I didn't agree with the content	0	0.0%
I felt silly/embarrassed sending people videos	120	19.5%
Other, please write in	29	4.7%
Total	614	100%

*Number of respondents who responded to the mid-semester survey. 614 respondents answered the question, "If you didn't share any videos, why not? Mark all that apply."

Table 25. Perceived helpfulness of agent of change videos in learning and memorizing course content (n=651)

Answer	Count	%
Not at all helpful for my learning/intellectual growth	181	27.9%
Slightly helpful for my learning/intellectual growth	213	32.8%
Moderately helpful for my learning/intellectual growth	154	23.7%
Solidly helpful for my learning/intellectual growth	81	12.5%
Very helpful for my learning/intellectual growth	21	3.2%
Total	650	100%

*Number of respondents who responded to the mid-semester survey. 650 respondents answered the question, "How helpful are the videos for learning and memorizing course content?"

Paired sample t-tests were conducted to analyze overall changes from the beginning to the end of the course in outcome measures within the 2020 no-AOC Cohort and the 2021 AOC Cohort, and are presented in Tables 26 and 27, respectively. Students in the 2020 no-AOC Cohort demonstrated significant increases in nutrition knowledge score (p< .0001), and intakes of whole grain ounce equivalents/day (p< .0001), fiber grams/day (P< .0001), and vegetables cup equivalents/day (p< .0001), and significant decreases in dairy cup equivalents/day (p= .0001) and total added sugar teaspoon equivalents/day (p= .0001) (Table 26).

Within the 2021 AOC Cohort there was also a significant increase in the change in nutrition knowledge score (p< .0001) and a significant decrease in total added sugar teaspoon equivalents/day total added sugar (p=.0001) (Table 27). However, there were significant decreases pre versus post in the intakes of whole grain cup equivalents/day (p= .029), fiber grams/day (p< .0001), vegetable cup equivalents/day (p= < .0061), and dairy cup equivalents/day (p= .0001) (Table 27).

Tables 28 - 31 present multiple linear regression results for the 2020 and the 2021 Cohorts to investigate predictors of change in nutrition knowledge and dietary intake, while controlling for age, nutrition knowledge pre-score, gender, and motivation for taking the course. For the 2020 Cohort males compared to females (Beta= -1.48, p= .01), older versus younger students (Beta= -0.65, p=.0007) and those with a high nutrition knowledge pre-score (Beta= -0.63, p< .0001) demonstrated greater lower changes in nutrition knowledge scores pre versus post course. In addition, as student age increased, changes in vegetables significantly decreased (Beta= -0.02, p= .048). Males compared to females saw a significant greater change in fiber grams/day (Beta=0.442, p= .02), vegetables cup equivalents/day (Beta= 0.06, p = .036), and a

significant lower change in dairy cup equivalents/day (Beta = -0.08, p= .042). As nutrition knowledge pre-score increased, change in total added sugars significantly increased (Beta= 0.031, p= .049) (Tables 28 & 29).

For the 2021 Cohort, only students' nutrition knowledge pre-score was associated with change in nutrition knowledge (-0.560, p <.0001). As students age increased, there was a significantly higher change in dairy intake (Beta= 0.025, p= .046) (Tables 30 & 31).

Table 26. Change in outcome means[b] for the 2020 no-AOC Cohort: Total and by gender

Change (post – pre results) in:	2020 no-AOC Cohort Total[a]			2020 no-AOC Cohort Males[a]			2020 no-AOC Cohort Females[a]		
	n	**Mean**	**p-value**	*n*	**Mean**	**p-value**	*n*	**Mean**	**p-value**
Nutrition knowledge score	795	10.95	<.0001	260	9.67	<.0001	535	11.58	<.0001
Whole grains (ounce equiv/day)	761	0.54	<.0001	243	0.06	.0162	518	0.05	<.0001
Fiber (grams/day)	701	0.35	<.0001	217	0.60	.0016	484	0.24	.0052
Fruits/Veg, legumes no FF (cup equiv/day)	745	0.031	.1593	236	0.08	.1043	509	0.01	.7442
Vegetables, legumes no FF (cup equiv/day)	748	0.032	.0061	236	0.08	.1043	510	-0.92	<.0001
Fruits (cup equiv/day)	767	0.00014	.9919	245	0.02	.6255	522	-0.01	.5953
Dairy (cups/day)	759	-0.069	.0001	242	-0.09	.0408	517	-0.06	.0003
Total added sugars (tsp equiv/day)	741	-0.55	.0001	231	-0.97	.0101	509	-0.36	.0022

p-value <0.05; p-value <0.01; p-value <0.00
[a]Paired t-test results comparing study outcome means pre versus post[b] for the total 2020 no-AOC Cohort, between males, and between females.
[b]Study outcomes include changes in: nutrition knowledge score; intakes of whole grains; fruits/vegetables, legumes no French fries (FF); Vegetables; legumes no FF; Fruits; Dairy; Total added sugars

Table 27. Change in outcome means[b] for the 2021 no-AOC Cohort: Total and by gender

Change (post – pre results) in:	2021 AOC Cohort Total[a,]			2021 AOC Cohort Males[a]			2021 AOC Cohort Females[a]		
	n	Mean	p-value	*n*	Mean	p-value	*n*	Mean	p-value
Nutrition knowledge score	602	10.27	<.0001	155	9.41	<.0001	446	10.57	<.0001
Whole grains (ounce equiv/day)	582	-0.26	.0285	142	-0.00	.9057	440	0.04	.0062
Fiber (grams/day)	556	-0.18	.0683	140	-0.42	.0819	416	-0.10	.3308
Fruits/Veg, legumes no FF (cup equiv/day)	572	-0.10	<.0001	144	-0.11	.0367	428	-0.10	.0008
Vegetables, legumes no FF (cup equiv/day)	578	-0.02	.1576	145	-0.00	.9266	433	-0.03	.1104
Fruits (cup equiv/day)	581	-0.071	<.0001	145	-0.11	.0014	436	-0.06	.0003
Dairy (cups/day)	579	-0.10	<.0001	146	-0.12	.0158	433	-0.09	<.0001
Total added sugars (tsp equiv/day)	576	-0.51	.0021	146	-0.11	.8071	429	-0.64	<.0001

[a]Paired t-test results comparing study outcome means pre versus post[b] for the total 2021 AOC Cohort, between males, and between females.
[b]Study outcomes include changes in: nutrition knowledge score; intakes of whole grains; fruits/vegetables, legumes no French fries (FF); Vegetables; legumes no FF; Fruits; Dairy; Total added sugars

Table 28. Characteristics associated with pre to post changes in nutrition knowledge, intakes of whole grain, fiber, combined fruits and vegetables for the 2020 no-AOC Cohort

	Change in nutrition knowledge score			Change in whole grain (ounce equivalent/day)			Change in fiber (grams/day)			Change in fruit, vegetables, legumes, no FF[a] (cup equivalents/day		
	Beta coefficient	SE	p-value	Beta coefficient	SE	p-value	Beta coefficient	SE	p-value	Beta coefficient	SE	p-value
Age (<26 years)	-0.65	0.19	0.0007	-0.016	0.008	0.054	-0.080	0.063	0.204	-0.016	0.017	0.328
Nutrition knowledge pre-score (Scale 0-60)	-0.63	0.03	<.0001	0.0013	0.001	0.263	0.002	0.009	0.856	-0.001	0.002	0.549
Gender												
Male	-1.48	0.58	0.0104	0.011	0.024	0.638	0.442	0.192	0.022	0.076	0.051	0.134
Female	Reference			Reference			Reference			Reference		
Motivation to take course												
Not required	-0.51	0.53	0.3336	0.035	0.022	0.116	0.160	0.174	0.360	-0.020	0.046	0.671
Required	Reference			Reference			Reference			Reference		

Table 28 (cont'd)

R-squared	0.43	0.0118	0.012	0.005
Adjusted R-squared	0.43	0.0061	0.006	-0.001
N	719	701	644	685
Model p-value	<.0001	0.082	0.12	0.53

Note. [a]French fries (FF), Standard Error (SE)

Table 29. Characteristics associated with pre to post changes in intakes of vegetables, fruits, dairy, and total added sugar for the 2020 no-AOC Cohort

	Change in vegetables, legumes, no FF[a] (cup equivalents/day)			Change in fruits (cup equivalents/day)			Change in dairy (cup equivalents/day)			Change in total added sugar (teaspoons equivalents/day)		
	Beta coefficient	SE	p-value	Beta coefficient	SE	p-value	Beta coefficient	SE	p-value	Beta coefficient	SE	p-value
Age (< 26 years)	-0.017	.009	.048	-0.005	.011	.646	0.024	.014	.078	0.022	.110	.841
Nutrition knowledge pre-score (Scale 0-60)	-0.001	.001	.524	0.000	.002	.850	0.002	.002	.205	0.031	.015	.049
Gender												
Male	0.056	.027	.036	0.010	.033	.762	-0.083	.041	.042	-0.582	.334	.082
Female	Reference			Reference			Reference			Reference		
Motivation to take course												
Not required	-0.003	.024	.902	-0.009	.030	.751	0.060	.038	.112	-0.173	.304	.569
Required	Reference			Reference			Reference			Reference		
R-squared	0.011			0.001			0.013			0.012		

Table 29 (cont'd)

Adjusted R-squared	0.005	-0.005	0.008	0.006
N	688	707	701	683
Model p-value	.11	.99	.05	.10

[a]French fries (FF), Standard Error (SE)

Multiple linear regression model significant p-value <.05

Table 30. Characteristics associated with pre to post changes in nutrition knowledge, intakes of whole grain, fiber, combined fruits and vegetables for the 2021 AOC Cohort

	Change in nutrition knowledge score			Change in whole grain (ounce equivalent/day)			Change in fiber (grams/day)			Change in fruit, vegetables, legumes, no FF[a] (cup equivalents/day)		
	Beta coefficient	SE	p-value	Beta coefficient	SE	p-value	Beta coefficient	SE	p-value	Beta coefficient	SE	p-value
Age (<26 years)	0.096	.22	.664	0.004	.009	.664	0.055	.073	.449	-0.009	.018	.628
Nutrition knowledge pre-score (Scale 0-60)	-0.560	.04	<.0001	0.002	.001	.183	-0.014	.011	.208	-0.005	.003	.083
Gender												
Male	-1.379	.75	.066	-0.044	.028	.123	-0.361	.237	.129	-0.010	.059	.863
Female	Reference			Reference			Reference			Reference		
Motivation to take course												
Not required	0.214	.64	.738	0.027	.024	.270	-0.121	.204	.555	-0.074	.051	.147
Required	Reference			Reference			Reference			Reference		
R-squared	0.305			0.009			0.008			0.010		
Adjusted R-squared	0.300			0.002			0.001			0.003		
N	588			575			549			565		

Table 30 (cont'd)

Model p-value	<.0001	.26	.35	.24

Note. [a]French fries (FF), Standard Error (SE)

Table 31. Characteristics associated with pre to post changes in intakes of vegetables, fruits, dairy, and total added for the 2021 AOC Cohort

	Change in vegetables, legumes, no FF[a] (cup equivalents/day)			Change in fruits (cup equivalents/day)			Change in dairy (cup equivalents/day)			Change in total added sugar (teaspoons equivalents/day)		
	Beta coefficient	SE	p-value	Beta coefficient	SE	p-value	Beta coefficient	SE	p-value	Beta coefficient	SE	p-value
Age (< 26 years)	-0.003	.010	.736	-0.011	.010	.307	0.025	.013	.046	-0.080	.117	.493
Nutrition knowledge pre-score (Scale 0-60)	-0.002	.002	.129	-0.002	.002	.197	-0.001	.002	.689	0.018	.018	.336
Gender												
Male	0.024	.033	.474	-0.035	.035	.313	-0.036	.042	.394	0.652	.387	.093
Female	Reference			Reference			Reference			Reference		
Motivation to take course												
Not required	-0.025	.029	.383	-0.049	.030	.104	-0.022	.036	.537	0.402	.334	.229
Required	Reference			Reference			Reference			Reference		
R-squared	0.006			0.013			0.008			0.010		
Adjusted R-squared	-0.001			0.006			0.001			0.003		
N	571			574			572			569		

99

Table 31 (cont'd)

Model p-value	.48	.13	.32	.24

[a]French fries (FF), Standard Error (SE)

Multiple linear regression model significant p-value <.05

To compare overall differences in outcome measures between the two courses, Table 32 presents two sample t-test results comparing mean changes in outcome measures between the 2020 no-AOC Cohort and the 2021 AOC Cohort. There were no significant differences between the 2020 no-AOC Cohort and 2021 AOC Cohort in mean change in nutrition knowledge score, whole grain ounce equivalents/day, dairy cup equivalents/day, and total added sugar teaspoon equivalents/day. However, there were significant differences between the 2020 no-AOC Cohort and 2021 AOC Cohort in mean change in fiber 0.35, -0.18 grams/day, respectively (p<.0001), combined fruit and vegetables, 0.031, -0.10, respectively (p<.0001), mean change in vegetables cup equivalents/day 0.032, -0.02, respectively (p=.0045), and mean change in fruit cup equivalents per day 0.00014, -0.071, (p=.0005); with the 2021 AOC Cohort reporting greater lower changes in intakes of these foods compared to the 2020 Cohort.

Table 32. Comparison[a] of study outcome mean pre-post changes:[b] 2020 no-AOC Cohort versus 2021 AOC Cohort

Variables (change (post – pre results) in)	2020 no-AOC Cohort Mean change[a] (*n*=795)	2021 AOC Cohort Mean change (*n*=602)	Mean change difference[c]	p-value
Nutrition knowledge score (Scale 0-60)	10.95	10.27	0.68	.17
Whole grains (ounce equivalents/day)	0.54	-0.26	0.078	.085
Fiber (grams/day)	0.35	-0.18	0.536	<.0001
Fruits/Veg, legumes no FF (cup equivalents/day)	0.031	-0.10	0.13	<.0001
Vegetables, legumes no FF (cup equivalents/day)	0.032	-0.02	0.052	.0045
Fruits (cup equivalents/day)	0.00014	-0.071	0.071	.0005
Dairy (cups/day)	-0.069	-0.10	0.03	.23
Total added sugars (tsp equivalents/day)	-0.55	-0.51	-0.041	.85

[a]Two-sample t-test
[b]Study outcomes include changes in: nutrition knowledge score; intakes of whole grains; fruits/vegetables, legumes no French fries (FF); Vegetables; legumes no FF; Fruits; Dairy; Total added sugars
[c]Difference between means (2020 no-AOC Cohort Mean – 2021 AOC Cohort Mean)

To evaluate if the overall differences in outcome measure pre-post changes between 2020 no-AOC Cohort and 2021 AOC Cohort remained after controlling for age, nutrition knowledge pre-score, gender, and motivation for taking the course, multiple linear regression tests were performed and the results are presented in Tables 33 and 34. Compared to the 2020 no-AOC Cohort, the 2021 AOC Cohort demonstrated significantly lower increases in nutrition knowledge and significant decreases in intakes of fiber grams/day, combined fruits and vegetables cup equivalents/day, vegetable cup equivalents/day, and fruit cup equivalents/day. Age did not have a significant effect on pre-post changes in any outcome variables except for change in nutrition knowledge and change in dairy cup equivalents/day. Compared to the 2020 no-AOC Cohort, the 2021 AOC Cohort experienced a 0.29 lower change in nutrition knowledge score and a 0.02 decrease in dairy cup equivalents/day for every increase in one year of age.
Nutrition knowledge pre-score did not have a significant effect on pre-post changes in any outcome variable except for change in nutrition knowledge and change in total added sugars

teaspoon equivalents/day. Compared to the 2020 no-AOC Cohort, the 2021 AOC Cohort experienced a 0.60 lower change in nutrition knowledge score and a 0.03 higher change in total added sugar teaspoon equivalents/day for every one point increase in nutrition knowledge pre-score. Compared to females, males had a small but significant higher change in intake of vegetable cup equivalents/day (Beta=0.042, p=.045) and a significantly lower change in intake of dairy cup equivalents/day (Beta= -0.063, p=.034) and change nutrition knowledge score (Beta= -1.49, p= .001) Compared to students who were required to take the course, students who were not required to take to the course had a small but significant greater change in whole grain ounces/day intake (Beta= 0.033, p=.046)

Table 33. Comparison of mean changes in nutrition knowledge and intakes of whole grain, fiber, combined fruits and vegetables pre-post: 2020 no-AOC Cohort versus 2021 AOC Cohort controlling for age, nutrition knowledge pre-score, gender, and motivation for taking courses

	Change in nutrition knowledge score			Change in whole grain (ounce equivalent/day)			Change in fiber (grams/day)			Change in fruit, vegetables, legumes, no FF[a] (cup equivalents/day)		
	Beta coefficient	*SE*	p-value	Beta coefficient	*SE*	p-value	Beta coefficient	*SE*	p-value	Beta coefficient	*SE*	p-value
Year												
2021 AOC Cohort	-1.409	.41	.001	-0.027	.016	.100	-0.555	.132	<.0001	-0.128	.034	.0002
2020 no-AOC Cohort	Reference			Reference			Reference			Reference		
Age (<26 years)	-0.289	.15	.047	-0.007	.006	.260	-0.017	.048	.715	-0.013	.012	.275
Nutrition knowledge pre-score (Scale 0-60)	-0.598	.02	<.0001	0.002	.001	.084	-0.005	.007	.486	-0.003	.002	.117
Gender												
Male	-1.486	.46	.001	-0.013	.018	.498	0.086	.150	.570	0.040	.038	.302
Female	Reference			Reference			Reference			Reference		

Table 33 (cont'd)

Motivation to take course

Not required	-0.114	.41	.782	0.033	.016	.042	0.046	.133	.732	-0.043	.034	.21
Required	Reference			Reference			Reference			Reference		
R-squared	0.372			0.010			0.016			0.016		
Adjusted R-squared	0.370			0.006			0.012			0.012		
N	1307			1276			1193			1250		
Model p-value	<.0001			.032			.002			.0012		

Note. [a]French fries (FF), Standard Error (SE)

Table 34. Comparison of mean changes in intakes of vegetables, fruits, dairy, total added sugar pre-post: 2020 no-AOC Cohort versus 2021 AOC Cohort controlling for age, nutrition knowledge pre-score, gender, and motivation for taking courses

	Change in vegetables, legumes, no FF[a] (cup equivalents/day)			Change in fruits (cup equivalents/day)			Change in dairy (cup equivalents/day)			Change in total added sugar (teaspoons equivalents/day)		
	Beta coefficient	*SE*	p-value	Beta coefficient	*SE*	p-value	Beta coefficient	*SE*	p-value	Beta coefficient	*SE*	p-value
Year												
2021 AOC Cohort	-0.052	.018	.005	-0.068	.021	.001	-0.031	.026	.232	0.098	.223	.66
2020 no-AOC Cohort	Reference			Reference			Reference			Reference		
Age (< 26 years)	-0.011	.007	.092	-0.008	.008	.281	0.023	.009	.012	-0.019	.080	.81
Nutrition knowledge pre-score (Scale 0-60)	-0.001	.001	.137	-0.001	.001	.531	0.001	.001	.413	0.025	.012	.04
Gender												
Male	0.042	.021	.045	-0.008	.024	.735	-0.063	.029	.034	-0.056	.253	.82
Female	Reference			Reference			Reference			Reference		
Motivation to take course												
Not required	-0.011	.019	.545	-0.027	.021	.197	0.023	.026	.375	0.084	.224	.71
Required	Reference			Reference			Reference			Reference		

Table 34 (cont'd)

R-squared	0.013	0.011	0.009	0.004
Adjusted R-squared	0.009	0.007	0.005	-0.0001
N	1259	1281	1273	1252
Model p-value	.0049	.017	.045	.440

Note. [a]French fries (FF)

To determine if there were differences in mean changes in nutrition knowledge scores and dietary outcome measures between the three groups (2020 no-AOC Cohort, 2021 AOC-share group, and 2021 AOC-no share group), eight one-way ANOVA tests were performed, and the results are presented in Table 35. There were no significant differences in pre-post change in means between the three groups for mean change in nutrition knowledge score, whole grain ounce equivalents/day, total added sugar teaspoon equivalents/day, and dairy cup equivalents/day. However, there were significant differences between the change in means among the three Cohorts for: mean change in fiber grams/day ($F_{2,1219}$=10.68, p< .0001), combined fruit and vegetables cup equivalents/day ($F_{2,1277}$=9.35, P< .0001), vegetable cup equivalents/day ($F_{2,1284}$=5.56, p= .0039), and fruit ($F_{2,1308}$=7.00, p= .0009)

Bonferroni correction tests were performed for each of the ANOVA tests which produced a significant result to determine which means were significantly different from one another. Results are presented in tables 36-39 and reveal that there were no significant differences between the 2021 AOC-share group means and the 2021 AOC-no share group means for the following outcomes: mean change in fiber grams/day (Table 36), mean change in combined fruit and vegetable cup equivalents/day (Table 37), mean change in vegetable cup equivalents/day (Table 38), and mean change in fruit cup equivalents/day (Table 39). There were significant differences in mean change in combined fruit and vegetable cup equivalents/day (p= .0495) when comparing the 2020 no-AOC Cohort means (.031) with the 2021 AOC shared Cohort means (-0.068) (Table 37). There were also significant differences in means for change in fiber grams/day (p< .0001) when comparing the 2020 no-AOC Cohort means (0.35) with the 2021 AOC-no share group means (-0.41) (Table 36); change in combined fruit and vegetable cup equivalents/day (p= .0001) when comparing the 2020 no-AOC Cohort means (0.31) with the 2021 AOC-no share group means (-0.15) (Table 37); and change in vegetable cup equivalents/day (p= .0068) when comparing the 2020 no-AOC Cohort means (0.032) with the 2021 AOC-no share group means (-.041) (Table 38), and change in fruit cup equivalents/day (p= .0008) (Table 39).

Table 35. One-way analyses of variance summary of the effect of sharing videos on nutrition knowledge and dietary outcome measures

Outcome variables	df	Sum of Squares	Mean Square	F	P value	Corresponding Bonferroni comparison table
Change in mean nutrition knowledge score (Scale 0-60)	2	144.80	72.40	0.85	0.43	N/A
Change in mean whole grain intake (ounce equivalents/day)	2	0.19	0.09	1.12	0.33	N/A
Change in mean fiber intake (grams/day)	2	110.60	55.30	10.68	<.0001	See table 36
Change in mean fruits and vegetables, legumes, excluding FF intake (cup equivalents/day)	2	6.56	3.28	9.35	<.0001	See table 37
Change in mean vegetables, legumes, excluding FF intake (cup equivalents/day)	2	1.16	0.58	5.56	.0039	See table 38
Change in mean fruit intake (cup equivalents/day)	2	1.95	0.98	7.00	.0009	See table 39
Change in mean total added sugar intake (tsp equivalents/day)	2	2.86	1.43	0.10	0.91	N/A
Change in mean dairy (cup equivalents/day)	2	0.51	0.25	1.24	0.29	N/A

Each row is a separate ANOVA test

Sources of variation: Three levels: 1) 2020 no-AOC Cohort, 2) 2021 AOC-shared Cohort, 3) 2021 AOC-no share group

df = degrees of freedom

F = F statistic = variance of group means/ mean of the within group variances.

LSmean = Least Squares Means

Table 36. Bonferroni comparisons of change in fiber means among three groups

Mean	VS	Mean	LSmean	P value
2020 no-AOC Cohort[a]	vs	2021 AOC-shared Cohort[b]	0.35	0.0684
2020 no-AOC Cohort[a]	vs	2021 AOC-no share group[c]	-0.013	<.0001
2021 AOC-shared Cohort[b]	vs	2021 AOC-no share group[c]	-0.41	0.1368

Df = degrees of freedom

LSmean = Least Squares Means

[a]2020 no-AOC Cohort, *n*= 701, Mean = 0.35 (Standard Deviation (SD) = 2.21)

[b]2021 AOC-share group, *n*= 283. Mean = -0.013 (SD = 2.26)

[c]2021 AOC-no share group, *n*= 238. Mean = -0.41 (SD = 2.48)

Table 37. Bonferroni comparisons of change in fruits and vegetables, legumes excluding French fries means among three groups

Mean	VS	Mean	LSmean	P value
2020 no-AOC Cohort[a]	vs	2021 AOC-shared Cohort[b]	0.031	0.0495
2020 no-AOC Cohort[a]	vs	2021 AOC-no share group[c]	-0.068	0.0001
2021 AOC-shared Cohort[b]	vs	2021 AOC-no share group[c]	-0.148	0.3531

df = degrees of freedom

LSmean = Least Squares Means

[a]2020 no-AOC Cohort, *n*= 745, Mean = 0.031 (Standard Deviation (SD) = 0.59)

[b]2021 AOC-share group, *n*= 290, Mean = -0.068 (SD = 0.56)

[c]2021 AOC-no share group, *n*= 245. Mean = -0.148 (SD = 0.63)

Table 38. Bonferroni comparisons of change in vegetables including legumes excluding French fries means among three groups

Mean	VS	Mean	LSmean	P value
2020 no-AOC Cohort[a]	vs	2021 AOC-shared Cohort[b]	0.032	0.1114
2020 no-AOC Cohort[a]	vs	2021 AOC-no share group[c]	-0.014	0.0068
2021 AOC-shared Cohort[b]	vs	2021 AOC-no share group[c]	-0.041	1.00

df = degrees of freedom

LSmean = Least Squares Means

[a]2020 no-AOC Cohort· *n*= 748, Mean = 0.032 (Standard Deviation (SD) = 0.32)

[b]2021 AOC-share group, *n*= 294, Mean = -0.014 (SD = 0.33)

[c]2021 AOC-no share group, *n*= 245. Mean = -0.041 (SD = 0.33)

Table 39. Bonferroni comparisons of change in fruit means among three groups

Mean	VS	Mean	LSmean	P value
2020 no-AOC Cohort[a]	vs	2021 AOC-shared Cohort[b]	0.00014	0.2873
2020 no-AOC Cohort[a]	vs	2021 AOC-no share group[c]	-0.042	0.0008
2021 AOC-shared Cohort[b]	vs	2021 AOC-no share group[c]	-0.010	0.2221

df = degrees of freedom
LSmean = Least Squares Means
[a]2020 no-AOC Cohort, n = 767, Mean = 0.00014 (Standard Deviation (SD) = 0.39)
[b]2021 AOC-share group, n = 296, Mean = -0.042 (SD = 0.34)
[c]2021 AOC-no share group, n = 248, Mean = -0.010 (SD = 0.36)

To determine if the results and outcomes produced by the one-way ANOVA and Bonferroni correction tests remained while controlling for age, nutrition knowledge pre-score, gender, and motivation for taking the course, multiple linear regression tests were performed and the results are presented in Tables 40 and 41. Compared to the 2020 no-AOC Cohort, the 2021 AOC-share group and 2021 AOC-no share groups demonstrated significantly lower changes in fiber grams/day (-0.37, p=.022; -0.80, p<.0001, respectively), combined fruit and vegetable cup equivalents/day (-0.042, p=.023; -0.18, p<.0001), and vegetable cup equivalents/day (-0.045, p=.046; -0.76, p=.002). However, only the 2021 AOC-no share group demonstrated significantly lower changes in nutrition knowledge (-2.04, p= .0002) and fruit cup equivalents/day (-0.096, p=.001) 2020 no-AOC Cohort. Interestingly, the 2021 AOC-no share group demonstrated greater lower changes than the 2021 AOC-share group compared to the 2020 no-AOC Cohort: in change in nutrition knowledge score (-2.04, p=.0002; -0.67, p= .18); fiber grams/day (-0.80, p<.0001; -0.37, p=.02); combined fruits and vegetable cup equivalents/day (-0.18, p<.0001; -0.095, p=.02), and vegetable cup equivalents/day (-0.08, p=.002; -0.05, p=.046), respectively.

Table 40. Comparison of nutrition knowledge, whole grain, fiber, combined fruits and vegetable intake mean pre-post changes by study group controlling for age, nutrition knowledge pre-score, gender, and motivation for taking courses

	Change in nutrition knowledge score			Change in whole grain (ounce equivalent/day)			Change in fiber (grams/day)			Change in fruit, vegetables, legumes, no FF[a] (cup equivalents/day)		
	Beta coefficient	*SE*	p-value	Beta coefficient	*SE*	p-value	Beta coefficient	*SE*	p-value	Beta coefficient	*SE*	p-value
Shared videos												
2021 AOC-share group	-0.668	.50	.181	-0.025	.020	.218	-0.373	.163	.022	-0.095	.042	.023
2021 AOC-no share group	-2.035	.54	.0002	-0.022	.021	.306	-0.800	.173	<.0001	-0.179	.044	<.0001
2020 Cohort no video assignment												
Age (<26 years)	-0.261	.15	.074	-0.006	.006	.331	-0.008	.048	.862	-0.010	.012	.397
Nutrition knowledge pre-score (Scale 0-60)	-0.601	.02	<.0001	0.002	.001	.081	-0.005	.007	.462	-0.003	.002	.104
Gender												
Male	-1.571	.46	.001	-0.018	.019	.337	0.093	.153	.541	0.036	.039	.354
Female												
Motivation												

Table 40 (cont'd)

Not required	-0.046	.41	.911	0.038	.017	.022	0.074	.135	.585	-0.032	.034	.352
Required												
R-squared	0.378			0.010			0.020			0.018		
Adjusted R-squared	0.375			0.006			0.015			0.013		
N	1267			1237			1158			1213		
Model p-value	<.0001			.048			.0006			.0012		

[a]French fries (FF), Standard Error (SE)

Table 41. Comparison of mean changes in intakes of vegetables, fruits, dairy, total added sugar pre-post by study group adjusted for age, nutrition knowledge pre-score, gender, and motivation for taking courses

	Change in vegetables, legumes, no FF[a] (cup equivalents/day)			Change in fruits (cup equivalents/day)			Change in dairy (cup equivalents/day)			Change in total added sugar (teaspoons equivalents/day		
	Beta coefficient	*SE*	p-value	Beta coefficient	*SE*	p-value	Beta coefficient	*SE*	p-value	Beta coefficient	*SE*	p-value
Shared videos												
2021 AOC-share Cohort	-0.045	.023	.046	-0.040	.026	.126	-0.002	.031	.943	0.136	.273	.619
2021 AOC-no share group	-0.076	.024	.002	-0.096	.028	.001	-0.049	.034	.146	0.132	.291	.650
2020 no-AOC Cohort	Reference			Reference			Reference			Reference		
Age (<26 years)	-0.008	.007	.218	-0.008	.008	.288	0.022	.009	.015	-0.017	.081	.837
Nutrition knowledge pre-score (Scale 0-60)	-0.002	.001	.072	0.000	.001	.661	0.001	.001	.350	0.028	.012	.021
Gender												
Male	0.038	.021	.072	-0.007	.024	.776	-0.067	.029	.022	-0.083	.255	.744
Female	Reference			Reference			Reference			Reference		

Table 41 (cont'd)

Motivation												
Not required	-0.003	.019	.891	-.023	.021	.273	.033	.026	.208	0.114	.225	.614
Required	Reference			Reference			Reference			Reference		
R-squared	0.015			0.012			0.011			0.005		
Adjusted R-squared	0.011			0.007			0.006			0.0002		
N	1220			1244			1235			1215		
Model p-value	.0044			.021			.035			.410		

[a]French fries (FF), Standard Error (SE)

Simple and multiple linear regression tests were also conducted to investigate the relationship between sharing or not sharing videos on perceived agreement scores for each of the seven major food group statement categories while controlling for age, nutrition knowledge score pre-score, gender, and motivation for taking the course. Baseline frequencies and percentages regarding how each group scored are presented in Table 42. Results of the simple linear regression tests (Table 43) and the multiple linear regression tests (Tables 44 and 45) demonstrated significant differences between students that acted as agents of change (2021 AOC-share group) compared to students that did not (2021 AOC-no share group). After controlling for age, gender and motivation to take the course, compared to students in the 2021 AOC-no share group students in the 2021 AOC-share group had greater higher scores in each of seven major group statement categories areas: 1) perceived increase in knowledge about the health benefits of eating healthy foods (mean difference in scores: 1.88; p<.0001), 2) perceived increase in familiarity with healthy foods (mean difference in scores: 1.65; p<.0001), 3) perceived increase in ability to prepare healthy foods (mean difference in scores:2.54; p<.0001), 4) perceived increase in skills to eat healthy foods (mean difference in scores:2.53; p<.0001), 5) perceived confidence in ability to eat healthy foods (mean difference in scores 2.28 (p<.0001), 6) perceived motivation to eat more healthy foods (mean difference in scores 2.21 (p<.0001), and 7) perceived actual consumption of healthy foods (mean difference in scores 2.83 (p<.0001) (Tables 44 and 45).

Table 42 Perceived changes agreement score mean and standard deviations (SD) for the 2021 AOC Cohort, 2021 AOC-share group, and 2021 AOC-no share group

After completing the video assignments:	2021 AOC Cohort (*n*=777)			2021 AOC-share group (*n*=355)			2021 AOC-no share group (*n*=283)		
	Total (*n*=777) Mean (SD)	Males (*n*=203) Mean (SD)	Females (*n*=549) Mean (SD)	Total (*n*=355) Mean (SD)	Males (*n*=78) Mean (SD)	Females (*n*=261) Mean (SD)	Total (*n*=283) Mean (SD)	Males (*n*=82) Mean (SD)	Females (*n*=196) Mean (SD)
I know more about the health benefits of eating healthier foods[b] (agreement score scale 0-30)	24.82 (4.89)	23.38 (4.87)	25.31 (4.67)	25.86 (4.10)	25.04 (4.31)	26.13 (3.66)	23.71 (5.19)	22.13 (4.62)	24.32 (5.28)
I am more familiar with healthier foods[b] agreement score (agreement score scale 0-30)	24.79 (4.92)	23.34 (4.94)	25.29 (4.69)	25.75 (4.18)	25.07 (4.62)	25.98 (3.68)	23.83 (5.16)	22.25 (4.35)	24.45 (5.33)
I am better able to prepare or cook healthier foods score (0-30)	23.23 (5.50)	21.75 (5.32)	23.74 (5.38)	24.48 (4.73)	23.94 (5.01)	24.68 (4.37)	21.70 (5.75)	19.72 (5.10)	22.48 (5.82)
I have more skills to eat healthier foods[b] agreement score (agreement score scale 0-30)	24.43 (5.20)	23.14 (4.95)	24.89 (5.08)	25.74 (4.41)	25.03 (4.66)	25.99 (4.01)	22.96 (5.56)	21.63 (4.86)	23.48 (5.74)
I have more confidence in my ability to eat healthier foods[b] agreement score. (agreement score scale 0-30)	24.54 (5.35)	23.44 (5.26)	24.94 (5.20)	25.78 (4.55)	25.24 (4.58)	25.97 (4.23)	23.30 (5.73)	22.22 (5.46)	23.73 (5.79)
I am more motivated to eat healthier foods[b] agreement score. (agreement score scale 0-30)	24.81 (5.20)	23.77 (4.89)	25.19 (5.15)	26.01 (4.46)	25.34 (4.59)	26.26 (4.10)	23.52 (5.69)	22.50 (5.10)	23.92 (5.87)

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Table 42 (cont'd)

| I am eating more healthier foods[b] agreement score (agreement score scale 0-30) | 23.52 (5.07) | 22.64 (4.87) | 23.87 (4.99) | 24.69 (4.43) | 24.22 (4.42) | 24.90 (4.15) | 22.00 (5.64) | 20.99 (5.06) | 22.40 (5.81) |

Table 43 Regression analysis[a] summary for sharing or not sharing videos associated with agreement scores within seven major categories (Agreement Scale 0-30)

Outcome variables: seven major category agreement scores (Scale 0-30)	Beta coefficient[b] (SE)	P-value	R-squared
1. After completing the video assignments, I know more about the health benefits of eating healthier foods (agreement score scale 0-30) (*n*=570)	1.98 (.36)	<.0001	0.049
2. I am more familiar with healthier foods agreement score (agreement score scale 0-30) (*n*=570)	1.87 (.37)	<.0001	0.043
3. I am better able to prepare or cook healthier foods score (0-30) (n=568)	2.60 (.42)	<.0001	0.064
4. I have more skills to eat healthier foods agreement score (agreement score scale 0-30) (*n*=568)	2.44 (.39)	<.0001	0.064
5. After completing the video assignments, I have more confidence in my ability to eat healthier foods agreement score. (agreement score scale 0-30) (*n*=568)	2.35 (.4)	<.0001	0.057
6. After completing the video assignment, I am more motivated to eat healthier foods agreement score. (agreement score scale 0-30) (*n*=567)	2.32 (.4)	<.0001	0.055
7. I am eating more healthier foods agreement score (agreement score scale 0-30) (*n*=567)	2.50 (.4)	<.0001	0.065

[a] Simple linear regression. Predictor variable, shared or did not share videos; Outcome variables, seven agreement scores.

[b] Difference in change in outcomes for the 2021 AOC-sharing Cohort vs 2021 AOC-no sharing Cohort (reference).

Table 44. Standardized regression coefficients predicting perceived knowledge, familiarity, ability to cook, and more skills agreement scores (scale 0-30), controlling for age, nutrition knowledge pre-score, gender, and motivation for taking the course

Predictor variables	I know more about health benefits of eating healthier foods agreement score (scale 0-30)			I am more familiar with healthier foods agreement score (scale 0-30)			I am better able to prepare or cook healthier foods score (scale 0-30)			I have more skills to eat healthier foods agreement score (scale 0-30)		
	Beta coefficient	*SE*	p-value	Beta coefficient	*SE*	p-value	Beta coefficient	*SE*	p-value	Beta coefficient	*SE*	p-value
Share videos												
2021 AOC-share group	1.881	.364	<.0001	1.646	.366	<.0001	2.540	.426	<.0001	2.534	.401	<.0001
2021 AOC-no share group	Reference			Reference			Reference			Reference		
Age (<26 years)	-0.225	.127	.077	-0.215	.127	.092	0.100	.149	.503	-0.249	.140	.076
Nutrition knowledge pre-score (Scale 0-60)	0.093	.020	<.0001	0.101	.020	<.0001	0.088	.024	.0002	0.097	.022	<.0001
Gender												
Male	-1.396	.429	.001	-1.282	.431	.003	-1.735	.504	.001	-1.059	.475	.026
Female	Reference			Reference			Reference			Reference		
Motivation to take course												
Not required	0.536	.365	.143	0.426	.367	.246	0.492	.428	.250	-0.093	.403	.818
Required	Reference			Reference			Reference			Reference		
R-squared	0.116			0.107			0.112			0.121		
Adjusted R-squared	0.108			0.098			0.103			0.113		
N	546			546			544			544		
Model p-value	<.0001			<.0001			<.0001			<.0001		

Note. [a]French fries (FF), Standard Error (SE)

Table 45. Standardized regression coefficients predicting perceived confidence, motivation, and eating more agreement scores (scale 0-30), controlling for age, gender, and motivation for taking the course

Predictor variables	After completing videos, I have more confidence in my ability to eat healthier foods[b] agreement score. (scale 0-30)			After completing videos, I am more motivated to eat healthier foods[b] agreement score. (scale 0-30)			I am eating more healthier foods[b] agreement score (scale 0-30)		
	Beta coefficient	SE	p-value	Beta coefficient	SE	p-value	Beta coefficient	SE	p-value
Sharing videos									
2021 AOC-share group	2.280	.414	<.0001	2.213	.406	<.0001	2.378	.408	<.0001
2021 AOC-no share group	Reference			Reference			Reference		
Age (<26 years)	-0.287	.144	.047	-0.193	.142	.173	-0.164	.142	.250
Nutrition knowledge pre-score (Scale 0-60)	0.095	.023	<.0001	0.110	.023	<.0001	0.103	.023	<.0001
Gender									
Male	-0.712	.489	.146	-0.809	.480	.092	-0.708	.481	.141
Female	Reference			Reference			Reference		
Motivation to take course									
Not required	-0.308	.415	.459	-0.154	.408	.706	-0.099	.409	.809
Required	Reference			Reference			Reference		
R-squared	0.100			0.107			0.106		
Adjusted R-squared	0.091			0.099			0.097		
N	544			543			543		
Model p-value	<.0001			<.0001			<.0001		

Note. [a]French fries (FF), Standard Error (SE)

Discussion

The results from this study support further exploration into working with an introductory nutrition course as a healthy eating intervention and evaluating its effects on nutrition knowledge, dietary intake, and healthy eating attitudes and skills. We first studied whether taking a college introductory nutrition course improved nutrition knowledge and dietary intake and we found that both cohorts of students taking a college introductory nutrition course increased their nutrition knowledge scores and decreased their total added sugar consumption, while also finding that the 2020 no-AOC cohort additionally increased their consumption of whole grains, fiber, and vegetables. We also found that while controlling for age, nutrition knowledge pre-score, gender, and motivation for taking the course, adding an agent of change video sharing assignment to the college introductory nutrition course did not result in improved dietary outcomes, as measured by changes in whole grain, fiber, combined fruits and vegetables, vegetables, fruits, dairy, and total added sugar. Furthermore, compared to students in the cohort without the agent of change assignments (2020 no-AOC Cohort), students with the agent of change assignment (2021 AOC Cohort) demonstrated significant lower improvements in nutrition knowledge score, and significant decreases in intakes of fiber, combined fruit and vegetables, vegetables, and fruit.

The results also encourage additional investigation regarding how training college students as agents of change may enhance a student's learning and influence eating behaviors. In our study, compared to students in the cohort without the agent of change assignment, both groups with the agent of change assignment demonstrated lower changes in intake of fiber, combined fruits and vegetables, and vegetables.

Another interesting finding was that the magnitude of change among dietary outcome measures were relatively small over the course of the semester. For example, the mean change in intakes of combined fruits and vegetables for the 2021 AOC Cohort was -0.10 cup equivalents per day. Although this change is significantly different pre versus post course, the change may not be clinically significant, given that the U.S. Dietary Guideline recommendations for vegetables is > 2.5 daily cup equivalents and for fruit is > 2 daily cup equivalents.

Even though both groups with the agent of change assignment (2021 AOC-share group and 2021 AOC-no share group) demonstrated significant decreases in fiber, combined fruits and vegetables, and vegetable intake, we found that students in the 2021 Cohort that acted as agents

of change reported higher scores in perceived nutrition knowledge, familiarity with healthy foods, healthy food preparation, skills, confidence, and motivation to eat healthy foods, and consumption of healthy foods than students who did not act as agents of change.

To our knowledge, relatively few dietary interventions have explored using a semester long course as a dietary intervention with young adults[11-16,95] and no studies worked with students as agents of change to improve nutrition knowledge and healthy eating. Most of the studies reported significant dietary changes pre versus post course. Ha et al,[14] and Hager et al[13] reported significant increases in intakes of vegetables, fruit, and whole grains pre versus post course. Hekler et al[95] reported increases in "dietary scores" and servings of vegetables pre versus post course. Unlike our findings for the 2020 no-AOC Cohort, but similar to our findings among the 2021 AOC Cohort, Brown et al[12] and Hekler et al[95] reported no changes in average total vegetable intake and fruit intake pre versus post course, respectively.

Unlike this study, all studies with a semester long course as a nutrition intervention investigated courses that were taught in person rather than online except for one,[13] Interestingly, in the study of a course that had an online option, Hager et al[13] reported that students who participated in-person had greater increases in self-reported servings of fruits, vegetables and whole grains compared to students who completed the course online. This same study also reported that students in the online course reported less agreement with the statement, "I eat a healthier diet than I would have without the [course]." Since more online courses are being offered, future research may want to explore the effect of online versus in-person courses on diet.

The results from this study encourage further exploration regarding the effect of student living environments on dietary intake. For example, despite both courses being online and taking place during the Covid-19 pandemic, most students in the 2020 no-AOC Cohort were living off campus with their parents, caregivers, or on their own. Most students returned to campus and were living on or near campus during the 2021 AOC Cohort. These housing and social support differences may have contributed to differences observed in this study between the cohorts, with students living off campus showing more improvements in diet over the course of the semester than those living on campus. Future studies would benefit from controlling variables such as where students live, healthy eating social support, and changes in access to healthier foods.

This study's strengths included its large sample size and use of validated questionnaires including the National Cancer Institute's Dietary Screener Questionnaire (DSQ)[155], the Jones

Nutrition Knowledge questionnaire,[154] and questions from the 1992 National Health Interview Survey.[156] However, results from this study should be carefully interpreted for several reasons. First, the sample of subjects self-selected into the courses and were not randomized. As a result, findings from this study may not be transferrable to college students or young adults in the general population. A large percentage of students in both courses reported being interested in learning about healthier eating strategies. This level of interest may make our study population different in some way from the general population of young adults. In addition, the gender distribution of the sample within our study does not reflect the gender distribution of the university within which this study took place, which reports that 53% of its students are female and 47% are male, compared to our sample's gender distribution of 68% female and 31% male. This overrepresentation of female students and underrepresentation of male students may introduce gender and selection bias into the results. Lastly, we were unable to control for where students lived during both courses. This may have impacted access to healthier foods, given that students living at home with parents or caregivers may have better access to healthier foods compared to students living on their own.

Implications for Research and Practice:

The results of this study support the need for further research investigating how best to improve dietary behaviors among young adults. Young adults are a large and important population group, who consume below U.S. Dietary Guideline recommendations. The young adult life stage is an important period where dietary habits and food preferences are developing and where dietary choices may impact future offspring and it is important to create effective interventions that have the correct balance of intensity, dosage, and combination of strategies to produce dietary changes. Our results support the idea that university introductory nutrition courses can be effective at increasing nutrition knowledge and improving diets. Moreover, our results demonstrated that students acting as agents of change for healthy eating for their friends and family was associated with increased perceptions of familiarity, skills, confidence, motivation and consumption of healthy foods.

CHAPTER 6 - SUMMARY, CONCLUSIONS, AND FUTURE RESEARCH

The research in this dissertation examined the effects of two agent of change nutrition interventions. The first intervention sought to improve selection of fruits and vegetables among school aged youth (5-18 years) attending public schools. The second intervention was designed to improve dietary intake among young adults (18-25 years). Overall, the studies included in this dissertation research evaluated: 1) whether school nutrition professionals acting as agents of change improved Smarter Lunchroom Scorecard scores and student selection of fruit and vegetables among students enrolled in Michigan public schools; 2) dietary intake and characteristics associated with dietary intake among college students participating in an agent of change introductory human nutrition course; 3) whether college students participating in an agent of change introductory human nutrition course made greater changes in nutrition knowledge and diet compared to college students in a course without the agent of change assignment; and 4) whether college students enrolled in the agent of change introductory human nutrition course who acted as agents of change perceived greater improvements in healthy eating knowledge, familiarity, skills, confidence, motivation, and healthier food consumption than students who did not act as agents of change.

In the first intervention, discussed in chapter 3, we found that school nutrition professionals significantly and positively increased their Smarter Lunchroom Scorecard scores pre versus post intervention and acted as agents of change by implementing behavioral economic strategies within their school cafeterias. However, we also found that increases in cafeteria Scorecard scores did not translate into increased selection of fruits and vegetables by school children in their cafeterias. Limited evidence was found supporting some of the individual fruit and vegetable strategies listed on the Scorecard. Future research should explore which behavioral economic strategies are effective in increasing selection and most importantly consumption of healthier foods by school children.

In a cross-sectional study, discussed in chapter 4, we evaluated the dietary intake and associated characteristics among college students enrolled in an agent of change introductory human nutrition course. This investigation provided evidence that dietary intakes of young adults are sub-optimal and do not meet the U.S. Dietary Guidelines recommendations for fruits and vegetables;[87,153] whole grains[22] and legumes.[26] Chapter 4 also presented findings that nutrition

knowledge, perceived cost, social support, and ease of eating are factors associated with healthy eating.

In the second intervention, discussed in chapter 5, we examined the effects of adding an agent of change assignment to an introductory human nutrition course on diet, nutrition knowledge, and student perceived changes in knowledge, familiarity, preparation ability, skills, confidence, motivation to eat healthier foods, and perceived changes in consumption of healthier foods. We found that students in both the course without the agent of change assignment and the course with the agent of change assignment significantly increased their nutrition knowledge scores and decreased their intake of total added sugar pre versus post course. Students in the course without the agent of change assignment additionally increased their consumption of whole grains, fiber, and vegetables. In contrast to our hypothesis, we found that while controlling for age, nutrition knowledge pre-score, gender, and motivation for taking the course, adding an agent of change video sharing assignment to the college introductory nutrition course did not improve dietary outcomes, as measured by change in whole grain, fiber, combined fruits and vegetables, vegetables, fruits, dairy, and total added sugar. However, students in the group who acted as agents of change and shared healthy eating videos with their friends and family members reported greater higher scores in perceived nutrition knowledge, familiarity with healthy foods, healthy food preparation, skills, confidence, motivation to eat healthy foods, and perceived consumption of healthy foods compared to students who did not act as agents of change.

This research lends credibility to the idea that programs who deliver nutrition education to clients/customers, such as Extension service offices, the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), school systems, university health promotion programs, and university food and nutrition departments may benefit from exploring incorporating agent of change activities into their programming. Agents of change programming to deliver nutrition education may reduce intervention costs, increase healthy eating message salience, and expand healthy eating programming reach. For example, Extension agencies could build upon this research and create an agent of change training program whereby school food service professionals learn how to intervene within their cafeterias to increase and measure healthy eating among students; WIC could train its clients as "agents of change" to encourage their family and friends to eat healthier foods.

To our knowledge, no previous studies have utilized an agent of change intervention approach with school food service professionals to improve the school cafeteria environment or with college aged students acting as change agents to convey nutrition information to family members/friends. Future researchers investigating agent of change healthy eating interventions might first explore how agents of change can most effectively be leveraged to improve dietary behaviors of school aged youth and family and friends of university students. More research is needed to better understand the effects on the recipient of the agent of change activities. For example, additional research might help build the research base exploring how knowledge, attitudes, barriers, and dietary behaviors are influenced or changed from an agent of change intervention. Once effective interventions are identified, there is also a need for future research to explore if and how to scale up agent of change interventions. Lastly, future research might explore if and how technology such smartphones, text messaging, or web-based applications could be used to train and support agents of change interventions.

The results from the school-based intervention demonstrate that future research is needed to identify effective school-based healthy eating programming using behavioral economic strategies. The review of the evidence supporting each of the fruit and vegetable Scorecard strategies raised many questions. For example, which strategies and for which age groups work best? If strategies are done in concert and at greater "dosage," will a greater effect be observed? Should future iterations of the Scorecard only include strategies supported by research conducted within schools and among students in grades kindergarten through twelfth? Answering these questions may assist child nutrition professionals in identifying which strategies to implement to increase selection of fruits and vegetables. In addition, more rigorous study designs are needed to control for external confounding variables such as type of menu choices being served, differences in leadership skills and style at each school site, student grade levels, concurrent external health promotion events, and student socio economic status.

The results from the university-based intervention also suggest that more research is needed to describe the dietary intake of young adults and to better identify and understand healthy eating barriers and facilitators within this important age group. Future studies would benefit from randomization and controlling for confounding variables such as: socioeconomic status, race/ethnicity, on campus/off campus, access to transportation, health conditions, and food preferences. In addition, future research might also benefit by adding more robust dietary intake

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measures as part of the intervention. For example, in addition the using the Dietary Screener Questionnaire, 24-hour food recalls might be used to reduce measurement errors due to recall and social desirability bias.[177] It would also be valuable to incorporate a validated food attitudes and behavior survey as well as qualitive analysis component to better capture and understand barriers and facilitators to healthy eating.

Future research is also needed to explore the effect of using an agent of change approach with family and friends such as evaluating the effect of receiving agent of change videos and information on family members who received the information. Did family members who received the agent of change videos change their eating behaviors? Which food groups changed most? Was receiving agent of change videos an enjoyable and engaging way to learn about healthier eating practices? Lastly, future interventions might also benefit from more specifically addressing one or more of the key healthy eating barriers reported in this dissertation research: perceived cost, social support, taste, and ease of eating healthy foods, as well as nutrition knowledge. For example, focus groups could be conducted with young adults and their family members regarding ways to overcome these barriers and findings could be incorporated in a future intervention.

In summary, more rigorous research working with agents of change approaches within nutrition interventions are needed. For nutrition researchers who are interested in exploring ways to deliver effective interventions to large populations, agents of change approaches may be a solution. We know that globally and within the U.S. interventions are needed to nudge populations to consume healthier dietary patterns.[24] In fact, it has been reported that the need for such interventions are so great that prevention efforts should take place across all life stages, genders, and racial and ethnic groups in people with and without chronic diseases.[1] Thus, identifying effective interventions incorporating agents of change approaches within them may have the potential to benefit individuals, their families and the communities within which they live.

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APPENDIX A - SMARTER LUNCHROOM SCORECARD

Figure 1.

Smarter Lunchrooms Self-Assessment — 2016 Scorecard
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Since its founding in 2009 the Smarter Lunchrooms Movement has championed the use of evidence-based, simple low and no-cost changes to lunchrooms which can simultaneously improve participation and profits while decreasing waste. This tool can help you to evaluate your lunchroom, congratulate yourself for things you are doing well and and identify areas of opportunity for improvement

Instructions

Read each of the statements below. Visualize your cafeteria, your service areas and your school building. Indicate whether the statement is true for your school by checking the box to the left. If you believe that your school does not reflect the statement 100% do not check the box on the left. After you have completed the checklist, tally all boxes with check marks and write this number in the designated area on the back of the form. This number represents your school's baseline score. The boxes which are not checked are areas of opportunity for you to consider implementing in the future. We recommend completing this checklist annually to measure your improvements!

It's not nutrition ...until it's eaten!

Important Words

Service areas: Any location where students can purchase or are provided with food

Dining areas: Any location where students can consume the food purchased or provided

Grab and Go Meals: Any meal with components pre-packaged together for ease and convenience – such as a brown bag lunch or "Fun Lunch" etc.

Designated Line: Any foodservice line which has been specified for particular food items or concepts – such as a pizza line, deli line, salad line etc.

Alternative entrée options: Any meal component which could also be considered an entrée for students - such as the salad bar, yogurt parfait, vegetarian/vegan or meatless options etc.

Reimbursable "Combo Meal" pairings: Any reimbursable components available independently on your foodservice lines which you have identified as a part of a promotional complete meal – For example you decided your beef taco, seasoned beans, frozen strawberries and 1% milk are part of a promotional meal called the, "Mi Amigo Meal!" etc.

Non-functional lunchroom equipment: Any items which are either broken, awaiting repair or are simply not used during meal service – such as empty or broken steam tables, coolers, registers etc.

Good Rapport: Communication is completed in a friendly and polite manner

All Points of Sale: Any location where a register/pin-pad is located for example: deli-line, snack window, a la carte line, hot line, kiosks/carts etc.

Focusing on Fruit

☐ At least two types of fruit are available daily

☐ Sliced or cut fruit is available daily

☐ Fruit options are not browning, bruised or otherwise damaged

☐ Daily fruit options are given creative, age-appropriate names

☐ Fruit is available at all points of sale (deli-line, snack windows, a la carte lines etc.)

☐ Daily fruit options are available in at least two different locations on each service line

☐ At least one daily fruit option is available near all registers (If there are concerns regarding edible peel, fruit can be bagged or wrapped)

☐ Whole fruit options are displayed in attractive bowls or baskets (instead of chaffing/hotel pans)

☐ A mixed variety of whole fruits are displayed together

☐ Daily fruit options are easily seen by students of average height for your school

☐ Daily fruit options are bundled into all grab and go meals available to students

☐ Daily fruit options are written legibly on menu boards in all service and dining areas

Promoting Vegetables & Salad

☐ At least two types of vegetable are available daily

☐ Vegetables are not wilted, browning, or otherwise damaged

☐ At least one vegetable option is available in all foodservice areas

☐ Individual salads or a salad bar is available to all students

☐ The salad bar is highly visible and located in a high traffic area

☐ Self-serve salad bar utensils are at the appropriate portion size or larger for all fruits and vegetable offered

☐ Self-serve salad bar utensils are smaller for croutons, dressing and other non-produce items

☐ Daily vegetable options are available in at least two different locations on each service line

☐ Daily vegetable options are easily seen by students of average height for your school

☐ A daily vegetable option is bundled into grab and go meals available to students

☐ A default vegetable choice is established by pre-plating a vegetable on some of the trays

☐ Available vegetable options have been given creative or descriptive names

☐ All vegetable names are printed/written on name-cards or product IDs and displayed next to each vegetable option daily

☐ All vegetable names are written and legible on menu boards

☐ All vegetable names are included on the published monthly school lunch menu

Moving More White Milk

☐ All beverage coolers have white milk available

☐ White milk is placed in front of other beverages in all coolers

☐ White milk crates are placed so that they are the first beverage option seen in all designated milk coolers

☐ White milk is available at all points of sale (deli-line, snack windows, a la carte lines etc.)

☐ White milk represents at least 1/3 of all visible milk in the lunchroom

☐ White milk is easily seen by students of average height for your school

☐ White milk is bundled into all grab and go meals available to students as the default beverage

☐ White milk is promoted on menu boards legibly

☐ White milk is replenished so all displays appear "full" continually throughout meal service and after each lunch period

Entrée of the Day

☐ A daily entrée option has been identified to promote as a "targeted entrée" in each service area and for each designated line (deli-line, snack windows, a la carte lines etc.)

☐ Daily targeted entrée options are highlighted on posters or signs

☐ Daily targeted entrée is easily seen by students of average height for your school

☐ Daily targeted entrées have been provided creative or descriptive names

☐ All targeted entrée names are printed/written on name-cards or product IDs and displayed next to each respective entrée daily

Figure 1 (cont'd)

- [ ] All targeted entrée names are written and legible on menu boards
- [ ] All targeted entrée names are included on the published monthly school lunch menu
- [ ] All targeted entrees are replenished so as to appear "full" throughout meal service

Increasing Sales
Reimbursable Meals

- [ ] A reimbursable meal can be created in any service area available to students (salad bars, snack windows, speed lines, speed windows, dedicated service lines etc.)
- [ ] Reimbursable "Combo Meal" pairings are available and promoted daily
- [ ] A reimbursable meal has been bundled into a grab and go meal available to students
- [ ] Grab and go reimbursable meals are available at a convenience line/speed window
- [ ] The convenience line offers only reimbursable grab and go meals with low-fat non-flavored milk fruit and/or vegetable.
- [ ] Grab and go reimbursable meals are easily seen by students of average height for your school
- [ ] The School offers universal free lunch
- [ ] A reimbursable combo meal pairing is available daily using alternative entrees (salad bar, fruit & yogurt parfait etc.)
- [ ] Reimbursable "Combo Meal" pairings have been provided creative or descriptive age-appropriate names (i.e. – The Hungry Kid Meal, The Athlete's Meal, Bobcat Meal etc.)
- [ ] Reimbursable "Combo Meal" pairing names are written/printed on name-cards, labels, or product IDs and displayed next to each respective meal daily
- [ ] All reimbursable "Combo Meal" names are written and legible on menu boards
- [ ] All reimbursable "Combo Meal" names are included on the published monthly school lunch menu
- [ ] Reimbursable "Combo Meal" pairings are promoted on signs or posters
- [ ] The named reimbursable "Combo Meal" is promoted during the school's morning announcements
- [ ] Students have the option to pre-order their lunch in the morning or earlier
- [ ] The cafeteria accepts cash as a form of payment

Creating School Synergies
Signage, Priming & Communication

- [ ] Posters displaying healthful foods are visible and readable within all service and dining areas
- [ ] Signage/posters/floor decals are available to direct students toward all service areas

- [ ] Signs promoting the lunchroom and featured menu items are placed in other areas of the school such as the main office, library or gymnasium.
- [ ] Menu boards featuring today's meal components are visible and readable within all service and dining areas
- [ ] A dedicated space/menu board is visible and readable from 5ft away within the service or dining area where students can see tomorrow's menu items
- [ ] Dining space is branded to reflect student body or school (i.e. – school lunchroom is named for school mascot or local hero/celebrity)
- [ ] All promotional signs and posters are rotated, updated or changed at least quarterly
- [ ] All creative and descriptive names are rotated, updated or changed at least quarterly
- [ ] A monthly menu is available and provided to all student families, teachers and administrators
- [ ] A monthly menu is visible and readable within the school building
- [ ] A weekly "Nutritional Report Card" is provided to parents detailing what their student has purchased during the previous week.

Lunchroom Atmosphere

- [ ] Trash on floors, in, or near garbage cans is removed between each lunch period
- [ ] Cleaning supplies and utensils are returned to a cleaning closet or are not visible during service and dining
- [ ] Compost/recycling/tray return and garbage cans are tidied between lunch periods
- [ ] Compost/recycling/tray return and garbage cans are at least 5ft away from dining students
- [ ] Dining and service areas are clear of any non-functional equipment or tables during service
- [ ] Sneeze guards in all service areas are clean
- [ ] Obstacles and barriers to enter service and dining areas have been removed (i.e. – garbage cans, mop buckets, cones, lost & found etc.)
- [ ] Clutter is removed from service and dining areas promptly (i.e. – empty boxes, supply shipments, empty crates, pans, lost & found etc.)
- [ ] Students artwork is displayed in the service and/or dining areas
- [ ] All lights in the dining and service areas are currently functional and on
- [ ] Trays and cutlery are within arm's reach to the students of average height for your school
- [ ] Lunchroom equipment is decorated with decals/magnets/signage etc. wherever possible

- [ ] Teachers and administrators dine in the lunchroom with students
- [ ] Cafeteria monitors have good rapport with students and lunchroom staff
- [ ] The dining space is used for other learning activities beyond meal service (i.e. – home economics, culinary nutrition education activities, school activities etc.)
- [ ] Staff is encouraged to model healthful eating behaviors to students (i.e. – dining in the lunchroom with students, encouraging students to try new foods etc.)
- [ ] Staff smiles and greets students upon entering the service line continually throughout meal service
- [ ] Students who do not have a full reimbursable meal are politely prompted to select and consume a fruit or vegetable option by staff

Student Involvement

- [ ] Student groups are involved in the development of creative and descriptive names for menu items
- [ ] Student groups are involved in creation of artwork promoting menu items
- [ ] Student groups are involved in modeling healthful eating behaviors to others (i.e. – mentors, high school students eating in the middle school lunchroom occasionally etc.)
- [ ] Student surveys are used to inform menu development, dining space décor and promotional ideas
- [ ] Students, teachers and/or administrators announce daily meal deals or targeted items in daily announcements

Recognition & Support of School Food

- [ ] The school participates in other food program promotions such as: Farm to School, Chefs Move to Schools, Fuel Up to Play 60, Share our Strength etc.)
- [ ] The school has applied or been selected for the Healthier US School Challenge
- [ ] A local celebrity (Mayor, sports hero, media personality) is invited to share lunch with student 3 to 4 time a year

A la Carte

- [ ] Students must ask to purchase a la carte items from staff members
- [ ] Students must use cash to purchase a la carte items which are not reimbursable
- [ ] Half portions are available for at least two dessert options

---

_____ **Total Checked**

Scoring Brackets

71-100 – Smarter Lunchrooms Gold
51-70 – Smarter Lunchrooms Silver
30-50 – Smarter Lunchrooms Bronze

It's not nutrition
...until it's eaten!

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APPENDIX B - MSU IRB LETTER OF APPROVAL

MICHIGAN STATE
UNIVERSITY

EXEMPT DETERMINATION
Revised Common Rule

March 3, 2021

To: Katherine Alaimo

Re: **MSU Study ID:** STUDY00005782
        Principal Investigator: Katherine Alaimo
        Category: Exempt 1
        Exempt Determination Date: 3/3/2021
        Limited IRB Review: Not Required.

Title: Formative Research to Inform A Future Dietary Intervention

This study has been determined to be exempt under 45 CFR 46.104(d) 1.

Principal Investigator (PI) Responsibilities: The PI assumes the responsibilities for the protection of human subjects in this study as outlined in Human Research Protection Program (HRPP) Manual Section 8-1, Exemptions.

Institutional restrictions to in-person human subject research activities conducted by MSU employees, MSU students, or agents of MSU are in place, but MSU is phasing in human research that has the potential for in-person interactions with participants, using a Tier approach. Restrictions to in-person interactions with human research participants by MSU employees, MSU students, or agents of MSU are in place until the activity is permitted under a Tier and a Human Research Plan for a Safe Return is approved. Visit http://hrpp.msu.edu/COVID-19/index.html for the restrictions, Tiers, forms, and the process.

Continuing Review: Exempt studies do not need to be renewed.

Modifications: In general, investigators are not required to submit changes to the Michigan State University (MSU) Institutional Review Board (IRB) once a research study is designated as exempt as long as those changes do not affect the exempt category or criteria for exempt determination (changing from exempt status to expedited or full review, changing exempt category) or that may substantially change the focus of the research study such as a change in hypothesis or study design. See HRPP Manual Section 8-1, Exemptions, for examples. If the study is modified to add additional sites for the research, please note that you may not begin the research at those sites until you receive the appropriate approvals/permissions from the sites.

Please contact the HRPP office if you have any questions about whether a change must be submitted for IRB review and approval.

Office of
Regulatory
Affairs
Human Research
Protection Program

4000 Collins Road
Suite 136
Lansing, MI 48910

517-355-2180
Fax: 517-432-4503
Email: irb@msu.edu
www.hrpp.msu.edu

APPENDIX C - CHAPTER 5 REPRINT PERMISSION
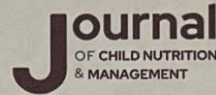
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Date   Date

APPENDIX D – PRE SURVEY

Welcome to HNF150!

Below is a pre-test survey that should take you about 20 minutes to complete. Completing the survey is worth 10 points toward your grade. At the end of the semester, you will be asked to complete a similar post-test.

This survey has been designed as a learning exercise linked to our unit on Nutrition Science. There are three types of questions in the survey: Knowledge, Attitude and Behavior questions. Most nutrition surveys used by scientists contain one or more of these three types of questions. While you are answering the questions, see if you can discern which type of question is being asked.

Student pre- and post-tests are useful for assessing where students are at the beginning of the semester and how their learning changes by the end of the semester. Student responses are used each year to improve the class.

Thank you！

Familiarity with Nutrition Concepts and Information

This is a survey, not a test. Your answers will help us identify what nutrition advice people find confusing and how familiar people are with nutrition.   It is important that you complete it without the help of others. If you don't know the answer, please mark "not sure" rather than guess or look up the answer.

These next items are about what advice about nutrition you think experts are giving. (Please choose only one answer for each.)

Q1 1. Which one of these is the current government food guide?

◯ Image:D46635df b5b2 4893 bb6c cda4d6c52f47

◯ Image:39ce2c24 70b0 4141 8a09 ac9b8d1a2491

◯ Image:Fae58fc7 0115 4d53 8bc0 ce51019730f1

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Q2 2. How well would you say you know the government's food guide, called MyPlate?

☐   Never heard of it

☐   Heard of, but know very little about it

☐   Know some about it

☐   Know a lot about it

Q3 3. How much would you say you know about whole grains?

○ Never heard of them

○ Heard of, but know very little about them

○ Know some about them

○ Know a lot about them

Q4 4. As far as you know, what are whole grains?

○ Grains that still have the bran and germ

○ Milled grains

○ Anything with added fiber

○ Refined flour

○ Not sure

Q5 5. Based on what you know, which of these isn't usually a whole grain?

○ Popcorn

○ Oatmeal

○ Flour tortillas

○ Brown rice

○ Not sure

Q6 6. Based on what you know, grains are an important source of…

○ Vitamin D

○ Vitamin K

○ B vitamins

○ Vitamin C

○ Not sure

Q7 7. As far as you know, which of these should you look for on a label to tell if a loaf of bread is whole wheat?

○ 100% wheat

○ Stone-ground wheat

○ Cracked wheat

○ Whole wheat is first in the ingredient list

○ Not sure

Q8 8. As far as you know, what amount of cooked vegetables is generally considered a serving?

○ ツシ cup

○ ツス cup

○ 1 cup

○ 2 cups

○ Not sure

Q9 9. Based on what you know, what is the amount of vegetables MyPlate (the government's food guide) recommends an adult should eat?

○ 1 to 2 cups each day

○ 2 to 3 cups each day

○ 6 to 7 cups each day

○ 5 to 6 cups each week

○ Not sure

Q10 10. Based on what you know, why does MyPlate (the government's food guide) recommend people eat a variety of vegetables?

○ To increase protein intake

○ Helps you get all your nutrients

○ It's better for the environment

○ To save money

○ Not sure

Q11 11. As far as you know, what is the amount of fruit MyPlate recommends an adult should eat?

○ 1 ツズ to 2 cups each day

○ 2 to 3 cups each day

○ 5 cups each day

○ 4 to 5 cups each week

○ Not sure

Q12 12. Based on what you know, fruit is an important source of which of these nutrients?

○ Protein

○ Vitamin C

○ Calcium

○ Vitamin B12

○ Not sure

Q13 13. Based on what you know, what type of dairy (milk, cheese, yogurt, etc) does MyPlate recommend?

○ None

○ Whole milk

○ Low fat and fat free

○ A mix of low fat and full fat

○ Not sure

Q14 14. Based on what you know, which of the following are some calcium-rich alternatives to milk?

○ Calcium-fortified juice

○ Canned fish with bones (such as sardines)

○ Kale and collard greens

○ All of the above

○ Not sure

Q15 15. Why do you think MyPlate recommends eating low-fat and lean meat and poultry?

○ They have more vitamins

○ To keep saturated fat low

○ To save money

○ They have more fiber

○ Not sure

Q16 16. Based on what you know, which of these is a safe way to defrost meat?

○ On the kitchen counter

○ In a bowl of hot water

○ In the oven

○ In the refrigerator

○ Not sure

Q17 17. Do you agree that some foods can be high in fat but not cholesterol?

○ Agree

○ Disagree

○ Not sure

X→ X→

Q18 18. How would you rate the healthfulness of each of the following types of fat?

	Healthy	Un-healthy	Not sure
Polyunsaturated fats	○	○	○
Monounsaturated fats	○	○	○
Saturated fats	○	○	○
Omega-3 fats	○	○	○
Trans fats	○	○	○

X→ X→

Q19 19. As far as you know, how are oils like olive and canola oil different from solid fats like butter and shortening?

○ Oils are usually lower in saturated fat

○ Oils raise LDL (bad) cholesterol

○ Oils are usually higher in saturated fat

○ Oils are always hydrogenated

○ Not sure

Q20 20. As far as you know, which fat do experts say is most important for people to eat less of?

○ Monounsaturated fat

○ Polyunsaturated fat

○ Saturated fat

○ Trans fat

○ Not sure

End of Block: Advice about Nutrition Experts are Giving

Start of Block: Nutrients in Food

These next few items are about the nutrients in foods. (Please choose only one answer for each.)

Q21 21. Do you agree that sunlight helps the body produce vitamin D naturally?

○ Agree

○ Disagree

○ Not sure

Q22 22. As far as you know, which of the following has the most calories?

○ 1 gram of sugar

○ 1 gram of protein

○ 1 gram of fiber

○ 1 gram of fat

○ Not sure

Q23 23. Do you agree that brown sugar is a healthier choice than white sugar?

○ Agree

○ Disagree

○ Not sure

Q24 24. Do you think these are high or low in salt when they are cooked without added salt?

	High	Low	Not sure
Cheese	○	○	○
Pasta without sauce	○	○	○
Red meat	○	○	○

Q25 25. Do you think these are high or low in fiber?

	High	Low	Not sure
Fish	○	○	○
Raspberries	○	○	○
Eggs	○	○	○
Red meat	○	○	○
Broccoli	○	○	○
Baked potato with skin	○	○	○

Q26 26. Do you think these foods are high or low in saturated fat when cooked without adding fat?

	High	Low	Not sure
Fish sticks	○	○	○
Whole milk	○	○	○
Olive oil	○	○	○
Red meat	○	○	○
Chocolate	○	○	○

Q27 27. A type of oil which contains mostly monounsaturated fat is…

○ Coconut oil

○ Soybean oil

○ Olive oil

○ Palm oil

○ Not sure

156

Q28 28. Based on what you know, which has more fat per serving?

○ Hot dogs

○ Ham

○ They both have the same

○ Not sure

Q29 29. Based on what you know, which has more fat per serving?

○ Peanuts

○ Air-popped popcorn

○ They both have the same

○ Not sure

Q30 30. As far as you know, cholesterol is found in…

○ Vegetables and vegetable oils

○ Animal products like meat and dairy products

○ All foods that have fat or oil

○ Not sure

Q31 31. As far as you know, if a product is labeled as only containing vegetable oil, it is…

○ Low in saturated fat

○ High in saturated fat

○ Could be either high or low in saturated fat

○ Not sure

Q32 32. Would you consider 100 milligrams of sodium to be a low or high amount for one serving of food?

○ Low

○ High

○ Not sure

Q33 33. Would you consider 20 grams of fat to be a low or high amount for one serving of food?

○ Low

○ High

○ Not sure

Q34 34. Would you consider 5 grams of fiber to be a low or high amount for one serving of food?

○ Low

○ High

○ Not sure

Q35 35. Would you consider 10 grams of saturated fat to be a low or high amount for one serving of food?

○ Low

○ High

○ Not sure

End of Block: Nutrients in Food

Start of Block: Health Benefits of Food

This next section is about health benefits of foods. (Please choose only one answer for each.)

Q36 36. Are you aware of any major diseases that eating enough fruit and vegetables might help prevent?

○ Yes

○ No

○ Not sure

Q37 37. If Yes, what major diseases does eating enough fruit and vegetables help prevent?
_____

Q38 38. Are you aware of any major diseases that eating enough fiber might help prevent?

   ◯ Yes

   ◯ No

   ◯ Not sure

Q39 39. If Yes, what major diseases does eating enough fiber help prevent?
_____

Q40 40. Are you aware of any major health problems or diseases that are related to how much salt people eat?

   ◯ Yes

   ◯ No

   ◯ Not sure

Q41 41. If Yes, what diseases or health problems do you think are related to salt?
_____

Q42 42. Do you think these help protect against certain kinds of cancer? (Please choose only one answer for each.)

	Yes	No	Not sure
Eating more fiber	◯	◯	◯
Eating less salt	◯	◯	◯
Eating more red meat	◯	◯	◯

Q43 43. Do you think these help protect against heart disease?

	Yes	No	Not sure
Eating less salt	○	○	○
Eating more red meat	○	○	○

Q44 44. How much would you say you know about antioxidants?

○ Never heard of them

○ Heard of, but know very little about them

○ Know some about them

○ Know a lot about them

Q45 45. Are the following antioxidant vitamins?

	Yes	No	Not sure
B vitamins	○	○	○
Vitamin C	○	○	○
Vitamin D	○	○	○
Vitamin E	○	○	○
Vitamin K	○	○	○

Q46 46. Neural tube defects are birth defects of the brain and spinal cord. Can eating any of these vitamins in early pregnancy help prevent these kinds of birth defects?

○ Vitamin A

○ Folic acid or folate

○ Vitamin D

○ None of these

○ Not sure

Q47 47. Which one of these is more likely to raise a person's blood cholesterol level?

○ Antioxidants

○ Polyunsaturated fats

○ Cholesterol in the diet

○ Saturated fats

○ Not sure

Q48 48. Which of the following statements about exercise and cancer do you agree with?

○ Exercise increases chances of some types of cancer

○ Exercise decreases chances of some types of cancer

○ Exercise makes no difference

○ Not sure

Q49 49. Which of the following statements about calories and weight gain do you agree with?

○ Calories from fats are most likely to cause weight gain

○ All calories cause the same weight gain

○ Calories from carbohydrates are most likely to cause weight gain

○ None of these

○ Not sure

End of Block: Health Benefits of Food

HNF150 Pretest Survey

Q50 50. In general, how healthy is your overall diet? Would you say it is . . .

○ excellent

○ very goof

○ good

○ fair

○ poor

Q51 51. There are plenty of healthy foods that taste good. Do you:

○ Strongly agree

○ Agree

○ Disagree

○ Strongly disagree

Q52 52. It is easy to eat a healthy diet. Do you:

○ Strongly agree

○ Agree

○ Disagree

○ Strongly disagree

Q53 53. In general, healthy foods cost more than other kinds of foods. Do you:

○ Strongly agree

○ Agree

○ Disagree

○ Strongly disagree

Q54 54. There is a lot of conflicting advice on healthy ways to eat. Do you:

○ Strongly agree

○ Agree

○ Disagree

○ Strongly disagree

Q55 55. I get encouragement from my family or friends to eat more healthy food. Do you:

○ Strongly agree

○ Agree

○ Disagree

○ Strongly disagree

Q56 56. Please tell me which statement you agree with MORE.

○ What people eat or drink has little effect on whether they will develop major chronic diseases, such as heart disease, cancer, and diabetes

○ By consuming the right kinds of foods and beverages, people can reduce their chances of developing major chronic diseases such as heart disease, cancer, and diabetes.

Q57 57. For the following food pair, please indicate which one you think contains more fiber?

○ 1 cup of low-fat yogurt

○ 1 cup of carrots

○ Both the same

○ Don't Know/Not sure

Q58 58. For the following food pair, please indicate which one you think contains more fiber.

○ 1 cup of spaghetti with meatballs

○ 1 cup of chili with beans

○ Both the same

○ Don't Know/Not sure

Q59 59. For the following food pair, please indicate which one contains more saturated fat.

○ 1 glass of coke

○ 1 glass of whole milk

○ Both the same

○ Don't Know/Not sure

Q60 60. For the following food pair, please indicate which one contains more saturated fat.

○ 1 tbs of butter

○ 1 tbs of sunflower oil

○ Both the same

○ Don't Know/Not sure

Q61 61. For the following food pair, please indicate which contains more omega-3 fatty acids

○ 1 tbs olive oil

○ 1 tbs flax seed oil

○ Both have the same

○ Don't Know/Not sure

Q62 62. For the following food pair, please indicate which contains more iron

○ 3 oz of Mussels

○ 3 oz of Roast beef

○ Both the same

○ Don't know/Not sure

Q63 63. Which of the following is the most calorie dense, i.e. has the most calories per gram?

○ Fat

○ Sugar

○ Salt

○ All are equal

○ Don't know/Not sure

Q64 64. In which organ does the majority of chemical digestion occur?

○ Stomach

○ Liver

○ Small intestine

○ Large intestine

○ Pancreas

○ Don't Know/Not sure

Q65 65. Rickets is caused by a deficiency of which vitamin?

○ Vitamin C

○ Vitamin E

○ Vitamin D

○ Vitamin A

○ Don't know/Not sure

Q66 66. Which of the following foods contains the least amount of antioxidant vitamins?

○ carrots

○ walnuts

○ chicken breast

○ lemon

○ wheat germ

○ Don't know/Not sure

Q67 67. The part of the food label with nutrition information is called the "Nutrition Facts" panel. How often do you use the Nutrition Facts panel when deciding to buy a food product?

○ Always

○ Most of the time

○ Sometimes

○ Rarely

○ Never

○ I've never seen a "Nutrition Facts" panel on a label

Q68 68. How interested are you in buying foods that are "low fat"?

1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
○	○	○	○	○	○	○	○	○	○

Q69 69. interested are you in buying foods that are "low carb"?

1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
○	○	○	○	○	○	○	○	○	○

Q70 70. How interested are you in buying foods that are "trans fat free"?

1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
○	○	○	○	○	○	○	○	○	○

Q71 71. How interested are you in buying foods that are "low in saturated fat"?

1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
○	○	○	○	○	○	○	○	○	○

Q72 72. How interested are you in buying foods that are "high in fiber"?

1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
○	○	○	○	○	○	○	○	○	○

Q73 73. How interested are you in buying foods that are "low sodium"?

1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
○	○	○	○	○	○	○	○	○	○

Q74 74. How interested are you in buying foods that are "fair trade"?

1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
○	○	○	○	○	○	○	○	○	○

Q75 75. How interested are you in buying foods that are "certified organic"?

1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
○	○	○	○	○	○	○	○	○	○

Q76 76. How interested are you in buying foods that are "locally grown"?

1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
○	○	○	○	○	○	○	○	○	○

Q77 77. How interested are you in buying foods that are "non-GMO"?

1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
○	○	○	○	○	○	○	○	○	○

Q78 78. How interested are you in buying foods that are "cholesterol free"?

1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
○	○	○	○	○	○	○	○	○	○

Q79 79. How would you rate the importance of the environmental impacts of your food?

1 Not at all important	2	3	4	5	6	7	8	9	10 Very important
○	○	○	○	○	○	○	○	○	○

Q80 80. How would you rate the importance of the treatment of animals involved in the production of your food?

1 Not at all important	2	3	4	5	6	7	8	9	10 Very important
○	○	○	○	○	○	○	○	○	○

Q81 81. How would you rate the importance of the working conditions of those who grow, make or sell your food?

1 Not at all important	2	3	4	5	6	7	8	9	10 Very important
○	○	○	○	○	○	○	○	○	○

Q82 82. How would you rate the importance that the workers who grew, picked, packaged, processed, transported and/or sold your food receiving a living wage (allowing workers to meet their basic needs like housing, food, clothing and transportation)?

1 Not at all important	2	3	4	5	6	7	8	9	10 Very important
○	○	○	○	○	○	○	○	○	○

HNF150 Pre-test Survey - Part 2 (Food Frequency Questions)

The following is a FOOD FREQUENCY QUESTIONNAIRE (FFQ) and is designed to ask people about their USUAL DIET. This FFQ has been developed by the National Cancer Institute of the National Institutes of Health and is widely used in nutrition research. We will be learning about other types of dietary assessment methods in future assignments.

These questions are about foods you ate or drank **during the past month, that is, in the past 30 days**. When answering, please include meals and snacks at home, at work or school, in restaurants, and anyplace else.

Q83 83. How do you identify yourself?

○ Male

○ Female

○ Additional gender category

○ Decline to answer

Q84 84. How old are you (in years)?
_____

170

Q85 85. During the past month, how often did you eat hot or cold cereals?

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

Q86 86. During the past month, what kind(s) of cereal did you usually eat? For example, Quaker granola, or Corn Pops, etc.

☐ Cereal 1 _____

☐ Cereal 2 _____

☐ Cereal 3 _____

☐ Cereal 4 _____

☐ Cereal 5 _____

Q87 87. During the past month, how often did you have any milk (either to drink or on cereal)? Include regular milks, chocolate or other flavored milks, lactose-free milk, buttermilk. Please do not include soy milk or small amounts of milk in coffee or tea.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2-3 times per day

○ 4-5 times per day

○ 6 or more times per day

Q88 88. During the past month, what kind of milk did you usually drink?

○ Whole or regular milk

○ 2% fat or reduced-fat milk

○ 1%, ツス%, or low-fat milk

○ Fat-free, skim or nonfat milk

○ Soy milk

○ Others (please specify) _____

Q89 89. During the past month, how often did you drink regular soda or pop that contains sugar? Do not include diet soda.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2-3 times per day

○ 4-5 times per day

○ 6 or more times per day

Q90 90. During the past month, how often did you drink 100% pure fruit juices such as orange, mango, apple, grape and pineapple juices? Do not include fruit-flavored drinks with added sugar or fruit juice you made at home and added sugar to.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2-3 times per day

○ 4-5 times per day

○ 6 or more times per day

Q91 91. During the past month, how often did you drink coffee or tea that had sugar or honey added to it? Include coffee and tea you sweetened yourself and presweetened tea and coffee drinks such as Arizona Iced Tea and Frappuccino. Do not include artificially sweetened coffee or diet tea.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2-3 times per day

○ 4-5 times per day

○ 6 or more times per day

Q92 92. During the past month, how often did you drink sweetened fruit drinks, sports or energy drinks, such as Kool-Aid, lemonade, Hi-C, cranberry drink, Gatorade, Red Bull or Vitamin Water? Include fruit juices you made at home and added sugar to. Do not include diet drinks or artificially sweetened drinks.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2-3 times per day

○ 4-5 times per day

○ 6 or more times per day

Q93 93. During the past month, how often did you eat fruit? Include fresh, frozen or canned fruit. Do not include juices.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

Q94 94. During the past month, how often did you eat a green leafy or lettuce salad, with or without other vegetables? Do not include salads made with spinach.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

Q95 95. During the past month, how often did you eat any kind of fried potatoes, including French fries, home fries, or hash brown potatoes?

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

Q96 96. During the past month, how often did you eat any other kind of potatoes, such as baked, boiled, mashed potatoes, sweet potatoes, or potato salad?

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

Q97 97. During the past month, how often did you eat refried beans, baked beans, beans in soup, pork and beans or any other type of cooked dried beans? Do not include green beans.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

Q98 98. During the past month, how often did you eat brown rice or other cooked whole grains, such as bulgur, cracked wheat, or millet? Do not include white rice.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

Q99 99. During the past month, not including what you just told me about (green salads, potatoes, cooked dried beans), how often did you eat other vegetables?

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

Q100 100. During the past month, how often did you have Mexican-type salsa made with tomato?

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

Q101 101. During the past month, how often did you eat pizza? Include frozen pizza, fast food pizza, and homemade pizza.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

Q102 102. During the past month, how often did you have tomato sauces such as with spaghetti or noodles or mixed into foods such as lasagna? Do not include tomato sauce on pizza.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

Q103 103. During the past month, how often did you eat any kind of cheese? Include cheese as a snack, cheese on burgers, sandwiches, and cheese in foods such as lasagna, quesadillas, or casseroles. Do not include cheese on pizza.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

Q104 104. During the past month, how often did you eat red meat, such as beef, pork, ham, or sausage? Do not include chicken, turkey or seafood. Include red meat you had in sandwiches, lasagna, stew, and other mixtures. Red meats may also include veal, lamb, and any lunch meats made with these meats.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

Q105 105. During the past month, how often did you eat any processed meat, such as bacon, lunch meats, or hot dogs? Include processed meats you had in sandwiches, soups, pizza, casseroles, and other mixtures. Processed meats are those preserved by smoking, curing, or salting, or by the addition of preservatives. Examples are: ham, bacon, pastrami, salami, sausages, bratwursts, frankfurters, hot dogs, and spam.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

Q106 106. During the past month, how often did you eat whole grain bread including toast, rolls and in sandwiches? Whole grain breads include whole wheat, rye, oatmeal and pumpernickel. Do not include white bread.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

Q107 107. During the past month, how often did you eat chocolate or any other types of candy? Do not include sugar-free candy.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

Q108 108. During the past month, how often did you eat doughnuts, sweet rolls, Danish, muffins, pan dulce, or pop-tarts? Do not include sugar-free items.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

Q109 109. During the past month, how often did you eat cookies, cake, pie or brownies? Do not include sugar-free kinds.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

Q110 110. During the past month, how often did you eat ice cream or other frozen desserts? Do not include sugar-free kinds.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

Q111 111. During the past month, how often did you eat popcorn?

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

End of Block: Food Frequency Questions

Start of Block: Environmental Influences

Environmental influences on fruit and vegetable

These questions are trying to better understand your eating environment as related to fruits and vegetables:

Q113 113. In an average week how often do you?

	Usually/Often	Sometimes	Rarely/Never	Does not apply to me
Ensure that at least two different types of fruits are available during meal times?	○	○	○	○
Ensure that at least two different vegetables are available during meal times?	○	○	○	○
Ensure that sliced or cut fruit is available during meal times?	○	○	○	○
Have access to fruit that is not bruised or otherwise damaged?	○	○	○	○
Have access to vegetables that are not wilting or otherwise damaged?	○	○	○	○
Have fruit placed in at least two locations where you prepare or consume food? (For example, bananas on the counter and strawberries in the refrigerator?	○	○	○	○
Have vegetables placed in at least two locations where you prepare or consume food? (For example, cucumbers in the refrigerator and onions on the counter?	○	○	○	○
Include a salad with at least one meal 3 or more days each week?	○	○	○	○

End of Block: Environmental Influences

Start of Block: Net ID

114 114 What is your motivation for taking HNF150? Select all that apply.

☐   It is required for my major, which is nutritional science

☐   It is required for my major, which is dietetics

☐   It is required for my major, which is food science

☐   It is required for my major, which is a major other than nutrition/dietetics

☐   I am interested in learning about how I can eat healthier

☐   I am concerned about a family member who is sick with a nutrition-related disease

☐   It just seemed like an interesting class

☐   My friends are taking the class

☐   I'm a foodie

☐   Others (please specify) _____

Q115 Q115 What is your __Net ID__?

This is what comes before the @msu.edu in your MSU email address. Be sure to spell it correctly to receive credit. We use your NetID in order to upload your credit for this assignment into the D2L gradebook.

Please do **__NOT__** give us your APID or student ID number -- this causes us a lot of difficulties when uploading your points into the D2L gradebook. Thanks!
_____

End of Block: Net ID

HNF150 Fall 2021 Mid-Survey
Start of Block: Default Question Block

Q1 The HNF150 professors strive to make the class a better learning experience for students each year. Your thoughtful, polite, and honest responses to the mid-course evaluation are very important. Before your answers are viewed, your NetID and identifying information will be deleted from the viewing file so that your answers will be read anonymously.

The last question asks you for your NetID. Your NetID is what comes before @msu.edu in your email address. We use your NetID to enter completion credit in the D2L grade book.

Thank you for helping us improve HNF150!

X→

Q2 1. What statement best describes your situation?

○ a current MSU student

○ a student from another college or university

○ a non-traditional student taking this as a single course for fun or personal benefit

○ a high school student planning to come to MSU

○ a high school student planning to attend a college or university elsewhere

Q3 2. What is the average amount of time you spend on this course per week?

○ 1-2 hours

○ 3-5 hours

○ 6-8 hours

○ 9-10 hours

○ 11-14 hours

○ 15-20 hours

○ 21-25 hours

○ 26+ hours

X→

Q4 3. How helpful are the recorded course lectures?

   ○ 1= Not at all helpful for my learning/intellectual growth

   ○ 2= Slightly helpful for my learning/intellectual growth

   ○ 3= Moderately helpful for my learning/intellectual growth

   ○ 4= Solidly helpful for my learning intellectual/growth

   ○ 5= Very helpful for my learning/intellectual growth

Q5 4. Please comment on your response to the lectures. Which aspects are most beneficial to your learning? Do you have suggestions for improvement?
_____

X→

Q6 5. Which textbook are you using for HNF 150?

   ○ Nutrition Concepts and Controversies by Sizer and Whitney

   ○ Wardlaw's Perspectives on Nutrition by Byrd-Bredbrenner

   ○ I did not use either textbook

X→

Q7 6. How helpful is the textbook?

   ○ 1= Not at all helpful for my learning/ intellectual growth

   ○ 2= Slightly helpful for my learning/intellectual growth

   ○ 3= Moderately helpful for my learning/intellectual growth

   ○ 4= Solidly helpful for my learning intellectual/growth

   ○ 5= Very helpful for my learning/ intellectual growth

   ○ 0= I did not use either textbook

X→

188

Q8 7. The electronic resources that come with the books are not required for the class. If you are using any of the electronic resources that came with the book, please rate how helpful they are to your learning:

○ 1= Not at all helpful for my learning/ intellectual growth

○ 2= Slightly helpful for my learning/intellectual growth

○ 3= Moderately helpful for my learning/intellectual growth

○ 4= Solidly helpful for my learning intellectual/growth

○ 5= Very helpful for my learning/ intellectual growth

○ 0= I did not use electronic resources that came with the book

Q9 8. Please comment on your response to the Textbook. What do you like about the book? What do you not like about the book?

_____

X→

Q10 9. How helpful are the webpages with learning materials in the Weekly folders (for example, Week 2: Topic 1 - Body Basics and Digestion) for your learning?

○ 1= Not at all helpful for my learning/ intellectual growth

○ 2= Slightly helpful for my learning/intellectual growth

○ 3= Moderately helpful for my learning/intellectual growth

○ 4= Solidly helpful for my learning intellectual/growth

○ 5= Very helpful for my learning/ intellectual growth

Q11 10. Please comment on your responses to the webpages with learning materials in the Weekly Folders. Which aspects were most beneficial to your learning? Do you have suggestions for improvement?

_____

X→

Q12 11. How helpful are the problem sets?

  ○ 1= Not at all helpful for my learning/ intellectual growth

  ○ 2= Slightly helpful for my learning/intellectual growth

  ○ 3= Moderately helpful for my learning/intellectual growth

  ○ 4= Solidly helpful for my learning intellectual/growth

  ○ 5= Very helpful for my learning/ intellectual growth

Q13 12. Please comment on your response to the problem sets. Which aspects are most beneficial to your learning? Do you have suggestions for improvement?

  _____

X→

Q14 13. How helpful are the PeaPod Discussions?

  ○ 1= Not at all helpful for my learning/ intellectual growth

  ○ 2= Slightly helpful for my learning/intellectual growth

  ○ 3= Moderately helpful for my learning/intellectual growth

  ○ 4= Solidly helpful for my learning intellectual/growth

  ○ 5= Very helpful for my learning/ intellectual growth

Q15 14. Please comment on your response to the PeaPod Discussions. Which aspects are most beneficial to your learning? Do you have suggestions for improvement?

  _____

X→

Q16 15. Have you shared the PeaPod videos you made with anyone?

  ○ Yes

  ○ No

X→

Q17 16. How many PeaPod videos have you shared?

○ 0

○ 1

○ 2

○ 3

○ 4

○ 5

X→

Q18 17. To how many people did you send the PeaPod video(s)?

○ 0

○ 1-2

○ 3-5

○ 6-10

○ 10-15

○ 15-20

○ 20+

X→

Q19 18. Who did you share the PeaPod video(s) with? Mark all that apply.

- [ ] Does not apply, I did not share the PeaPod videos with anyone

- [ ] Friend

- [ ] Acquaintance

- [ ] Parent/guardian

- [ ] Sibling

- [ ] Grandparent

- [ ] Aunt/Uncle

- [ ] Cousin

- [ ] Other family

- [ ] Co-worker

- [ ] Other (please specify) _____

X→

Q20 19. How did you share the PeaPod video(s)?

- ○ Does not apply, I did not share the PeaPod videos with anyone

- ○ Text

- ○ Email

- ○ Instagram/other social media

- ○ Other (please specify) _____

X→

Q21 20. What feedback did you receive from the person(s) you sent your videos to?

○ Does not apply, I did not share the PeaPod videos with anyone

○ I didn't get any response or reaction

○ Positive feedback

○ Negative feedback

○ Neutral feedback

○ Other (please specify) _____

Q22 21. Tell us about some of the feedback you received (write in here):
_____

X→

Q23 22. If you didn't share any videos or didn't share one or more of the videos, why not? Mark all that apply.

○ Does not apply, I shared all of the videos

○ I wasn't interested

○ I didn't think anyone would be interested in the videos

○ I forgot

○ My videos were not high quality

○ I didn't agree with the content

○ I felt silly/embarrassed sending people videos

○ Other – please write in _____

X→

Q24 23. How helpful are the pea pod videos for learning and memorizing course content?

○ 1= Not at all helpful for my learning/intellectual growth

○ 2= Slightly helpful for my learning/intellectual growth

○ 3= Moderately helpful for my learning/intellectual growth

○ 4= Solidly helpful for my learning/intellectual growth

○ 5 = Very helpful for my learning/intellectual growth

Q25 24. Please comment on your responses to the pea pod video activities. Which aspects are most beneficial to your learning? Do you have suggestions for improvement?
_____

X→

Q26 25. How helpful are the exams?

○ 1= Not at all helpful for my learning/ intellectual growth

○ 2= Slightly helpful for my learning/intellectual growth

○ 3=Moderately helpful for my learning/intellectual growth

○ 4= Solidly helpful for my learning intellectual/growth

○ 5= Very helpful for my learning/ intellectual growth

Q27 26. Please comment on your response to the Exams. Which aspects are most beneficial? Do you have suggestions for improvement?
_____

X→

Q28 27. Please rate the email system (fshn.hnf150@msu.edu) for the class in regards to how well and how quickly your questions were answered.

- ◯ 1= Not working at all
- ◯ 2= Working a little bit well
- ◯ 3= Working somewhat well
- ◯ 4= Working moderately well
- ◯ 5= Working very well
- ◯ 0= I did not use the email system

X→

Q29 28. Please rate Piazza for the class in regards to how well and how quickly your questions were answered and/or whether it was helpful for learning important information about the class.

- ◯ 1= Not working at all
- ◯ 2= Working a little bit well
- ◯ 3= Working somewhat well
- ◯ 4= Working moderately well
- ◯ 5= Working very well
- ◯ 0= I did not use the Piazza system

Q30 29. Please comment on your response to the Piazza system. Which aspects were most beneficial? Do you have suggestions for improvement?

_____

Q31 30. Which part of this course best helps you learn?

_____

Q32 31. Thinking about your individual style of learning (what works for you and what doesn't) -- do you have any other comments to share about what you like about the class or what would help your learning?

_____

Q33 **32. What is your <u>Net ID</u>?**

This is what comes before the @msu.edu in your MSU email address. Be sure to spell it correctly to receive credit. We use your NetID in order to upload your credit for this assignment into the D2L gradebook.

Please do **<u>NOT</u>** give us your APID or student ID number -- this causes us a lot of difficulties when uploading your points into the D2L grade book.

Thank you!

_____

APPENDIX F - POST SURVEY

Q1.1 HNF150 Post-survey

Below is a short post-test survey that should take you about 20 minutes to complete.

Student pre- and post-tests are useful for assessing where students are at the beginning of the semester and how their learning changes by the end of the semester. Student responses are used each year to improve the class. we appreciate you taking the time to thoughtfully answer the survey questions.

Thank you !

Q1.2 Familiarity with Nutrition Concepts and Information

 This is a survey, not a test. Your answers will help us identify what nutrition advice people find confusing and how familiar people are with nutrition.
   It is important that you complete it without the help of others.   If you don't know the answer, please mark "not sure" rather than guess or look up the answer.

These next items are about what advice about nutrition you think experts are giving. (Please choose only one answer for each.)

X→

1 Which one of these is the current government food guide?

○ Image:D46635df b5b2 4893 bb6c cda4d6c52f47

○ Image:39ce2c24 70b0 4141 8a09 ac9b8d1a2491

○ Image:Fae58fc7 0115 4d53 8bc0 ce51019730f1

X→

2 How well would you say you know the government's food guide, called MyPlate?

☐ Never heard of it

☐ Heard of, but know very little about it

☐ Know some about it

☐ Know a lot about it

X→

3 How much would you say you know about whole grains?

○ Never heard of them

○ Heard of, but know very little about them

○ Know some about them

○ Know a lot about them

X→

4 As far as you know, what are whole grains?

○ Grains that still have the bran and germ

○ Milled grains

○ Anything with added fiber

○ Refined flour

○ Not sure

X→

5 Based on what you know, which of these isn't usually a whole grain?

○ Popcorn

○ Oatmeal

○ Flour tortillas

○ Brown rice

○ Not sure

X→

6 Based on what you know, grains are an important source of…

○ Vitamin D

○ Vitamin K

○ B vitamins

○ Vitamin C

○ Not sure

X→

7 As far as you know, which of these should you look for on a label to tell if a loaf of bread is whole wheat?

○ 100% wheat

○ Stone-ground wheat

○ Cracked wheat

○ Whole wheat is first in the ingredient list

○ Not sure

X→

8 As far as you know, what amount of cooked vegetables is generally considered a serving?

○ ツシ cup

○ ツス cup

○ 1 cup

○ 2 cups

○ Not sure

[X→]

9 Based on what you know, what is the amount of vegetables MyPlate (the government's food guide) recommends an adult should eat?

○ 1 to 2 cups each day

○ 2 to 3 cups each day

○ 6 to 7 cups each day

○ 5 to 6 cups each week

○ Not sure

[X→]

10 Based on what you know, why does MyPlate (the government's food guide) recommend people eat a variety of vegetables?

○ To increase protein intake

○ Helps you get all your nutrients

○ It's better for the environment

○ To save money

○ Not sure

[X→]

11 As far as you know, what is the amount of fruit MyPlate recommends an adult should eat?

○ 1 ツス to 2 cups each day

○ 2 to 3 cups each day

○ 5 cups each day

○ 4 to 5 cups each week

○ Not sure

X→

12 Based on what you know, fruit is an important source of which of these nutrients?

○ Protein

○ Vitamin C

○ Calcium

○ Vitamin B12

○ Not sure

X→

13 Based on what you know, what type of dairy (milk, cheese, yogurt, etc) does MyPlate recommend?

○ None

○ Whole milk

○ Low fat and fat free

○ A mix of low fat and full fat

○ Not sure

X→

14 Based on what you know, which of the following are some calcium-rich alternatives to milk?

○ Calcium-fortified juice

○ Canned fish with bones (such as sardines)

○ Kale and collard greens

○ All of the above

○ Not sure

X→

15 Why do you think MyPlate recommends eating low-fat and lean meat and poultry?

○ They have more vitamins

○ To keep saturated fat low

○ To save money

○ They have more fiber

○ Not sure

X→

16 Based on what you know, which of these is a safe way to defrost meat?

○ On the kitchen counter

○ In a bowl of hot water

○ In the oven

○ In the refrigerator

○ Not sure

X→

17 Do you agree that some foods can be high in fat but not cholesterol?

○ Agree

○ Disagree

○ Not sure

X→

18 How would you rate the healthfulness of each of the following types of fat?

	Healthy	Un-healthy	Not sure
Polyunsaturated fats	○	○	○
Monounsaturated fats	○	○	○
Saturated fats	○	○	○
Omega-3 fats	○	○	○
Trans fats	○	○	○

X→

19 As far as you know, how are oils like olive and canola oil different from solid fats like butter and shortening?

○ Oils are usually lower in saturated fat

○ Oils raise LDL (bad) cholesterol

○ Oils are usually higher in saturated fat

○ Oils are always hydrogenated

○ Not sure

X→

20 As far as you know, which fat do experts say is most important for people to eat less of?

○ Monounsaturated fat

○ Polyunsaturated fat

○ Saturated fat

○ Trans fat

○ Not sure

Q2.22 **These next few items are about the nutrients in foods. (Please choose only one answer for each.)**

X→

21 Do you agree that sunlight helps the body produce vitamin D naturally?

○ Agree

○ Disagree

○ Not sure

X→

22 As far as you know, which of the following has the most calories?

○ 1 gram of sugar

○ 1 gram of protein

○ 1 gram of fiber

○ 1 gram of fat

○ Not sure

X→

23 Do you agree that brown sugar is a healthier choice than white sugar?

○ Agree

○ Disagree

○ Not sure

X→

24 Do you think these are high or low in salt when they are cooked without added salt?

	High	Low	Not sure
Cheese	○	○	○
Pasta without sauce	○	○	○
Red meat	○	○	○

X→

25 Do you think these are high or low in fiber?

	High	Low	Not sure
Fish	○	○	○
Raspberries	○	○	○
Eggs	○	○	○
Red meat	○	○	○
Broccoli	○	○	○
Baked potato with skin	○	○	○

X→

26 Do you think these foods are high or low in saturated fat when cooked without adding fat?

	High	Low	Not sure
Fish sticks	○	○	○
Whole milk	○	○	○
Olive oil	○	○	○
Red meat	○	○	○
Chocolate	○	○	○

X→

27 A type of oil which contains mostly monounsaturated fat is…

○ Coconut oil

○ Soybean oil

○ Olive oil

○ Palm oil

○ Not sure

X→

28 Based on what you know, which has more fat per serving?

○ Hot dogs

○ Ham

○ They both have the same

○ Not sure

X→

29 Based on what you know, which has more fat per serving?

- ○ Peanuts

- ○ Air-popped popcorn

- ○ They both have the same

- ○ Not sure

X→

30 As far as you know, cholesterol is found in…

- ○ Vegetables and vegetable oils

- ○ Animal products like meat and dairy products

- ○ All foods that have fat or oil

- ○ Not sure

X→

31 As far as you know, if a product is labeled as only containing vegetable oil, it is…

- ○ Low in saturated fat

- ○ High in saturated fat

- ○ Could be either high or low in saturated fat

- ○ Not sure

X→

32 Would you consider 100 milligrams of sodium to be a low or high amount for one serving of food?

- ○ Low

- ○ High

- ○ Not sure

X→

33 Would you consider 20 grams of fat to be a low or high amount for one serving of food?

- ○ Low
- ○ High
- ○ Not sure

X→

34 Would you consider 5 grams of fiber to be a low or high amount for one serving of food?

- ○ Low
- ○ High
- ○ Not sure

X→

35 Would you consider 10 grams of saturated fat to be a low or high amount for one serving of food?

- ○ Low
- ○ High
- ○ Not sure

Q2.38 <u>This next section is about health benefits of foods. (Please choose only one answer for each.)</u>

X→

36 Are you aware of any major diseases that eating enough fruit and vegetables might help prevent?

- ○ Yes
- ○ Not
- ○ Not sure

37 if Yes, what major diseases does eating enough fruit and vegetables help prevent?
_____

X→

38 Are you aware of any major diseases that eating enough fiber might help prevent?

○ Yes

○ Not

○ Not sure

---

39 If Yes, what major diseases does eating enough fiber help prevent?
_____

X→

40 Are you aware of any major health problems or diseases that are related to how much salt people eat?

○ Yes

○ No

○ Not sure

---

41 If Yes, what diseases or health problems do you think are related to salt?
_____

X→

42 Do you think these help protect against certain kinds of cancer? (Please choose only one answer for each.)

	Yes	No	Not sure
Eating more fiber	○	○	○
Eating less salt	○	○	○
Eating more red meat	○	○	○

X→

43 Do you think these help protect against heart disease?

	Yes	No	Not sure
Eating less salt	○	○	○
Eating more red meat	○	○	○

X→

44 How much would you say you know about antioxidants?

○ Never heard of them

○ Heard of, but know very little about them

○ Know some about them

○ Know a lot about them

X→

45 Are the following antioxidant vitamins?

	Yes	No	Not sure
B vitamins	○	○	○
Vitamin C	○	○	○
Vitamin D	○	○	○
Vitamin E	○	○	○
Vitamin K	○	○	○

X→

46 Neural tube defects are birth defects of the brain and spinal cord. Can eating any of these vitamins in early pregnancy help prevent these kinds of birth defects?

○ Vitamin A

○ Folic acid or folate

○ Vitamin D

○ None of these

○ Not sure

X→

47 Which one of these is more likely to raise a person's blood cholesterol level?

○ Antioxidants

○ Polyunsaturated fats

○ Cholesterol in the diet

○ Saturated fats

○ Not sure

X→

48 Which of the following statements about exercise and cancer do you agree with?

○ Exercise increases chances of some types of cancer

○ Exercise decreases chances of some types of cancer

○ Exercise makes no difference

○ Not sure

X→

49 Which of the following statements about calories and weight gain do you agree with?

○ Calories from fats are most likely to cause weight gain

○ All calories cause the same weight gain

○ Calories from carbohydrates are most likely to cause weight gain

○ None of these

○ Not sure

End of Block: Part 1 familiarity with nutrition concepts and information (Jones Survey Qs)

Start of Block: Part 2 questions from previous hnf 150 survey, not jones survey questions

X→

50 In general, how healthy is your overall diet? Would you say it is . . .

○ excellent

○ very good

○ good

○ fair

○ poor

X→

51 For each statement listed, select the answer that best indicates how much you personally agree or disagree with that statement. Use the scale of Strongly Disagree to Strongly Agree. If you don't understand a statement or don't have an opinion, please select "does not apply."

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Does not apply
There are plenty of healthy foods that taste good.	○	○	○	○	○	○
It is easy to eat a healthy diet.	○	○	○	○	○	○
In general, healthy foods cost more than other kinds of foods.	○	○	○	○	○	○
There is a lot of conflicting advice on healthy ways to eat.	○	○	○	○	○	○
I get encouragement from my family or friends to eat more healthy food.	○	○	○	○	○	○

X→

56 Please tell me which statement you agree with MORE.

○ What people eat or drink has little effect on whether they will develop major chronic diseases, such as heart disease, cancer, and diabetes

○ By consuming the right kinds of foods and beverages, people can reduce their chances of developing major chronic diseases such as heart disease, cancer, and diabetes.

X→

57 For the following food pair, please indicate which one you think contains more fiber?

○ 1 cup of low-fat yogurt

○ 1 cup of carrots

○ Both the same

○ Don't Know/Not sure

X→

58 For the following food pair, please indicate which one you think contains more fiber.

○ 1 cup of spaghetti with meatballs

○ 1 cup of chili with beans

○ Both the same

○ Don't Know/Not sure

X→

59 For the following food pair, please indicate which one contains more saturated fat.

○ 1 glass of coke

○ 1 glass of whole milk

○ Both the same

○ Don't Know/Not sure

X→

60 For the following food pair, please indicate which one contains more saturated fat.

○ 1 tbs of butter

○ 1 tbs of sunflower oil

○ Both the same

○ Don't Know/Not sure

X→

61 For the following food pair, please indicate which contains more omega-3 fatty acids

○ 1 tbs olive oil

○ 1 tbs flax seed oil

○ Both have the same

○ Don't Know/Not sure

X→

62 For the following food pair, please indicate which contains more iron

○ 3 oz of Mussels

○ 3 oz of Roast beef

○ Both the same

○ Don't know/Not sure

X→

63 Which of the following is the most calorie dense, i.e. has the most calories per gram?

○ Fat

○ Sugar

○ Salt

○ All are equal

○ Don't know/Not sure

X→

64 In which organ does the majority of chemical digestion occur?

○ Stomach

○ Liver

○ Small intestine

○ Large intestine

○ Pancreas

○ Don't Know/Not sure

X→

65 Rickets is caused by a deficiency of which vitamin?

○ Vitamin C

○ Vitamin E

○ Vitamin D

○ Vitamin A

○ Don't know/Not sure

X→

66 Which of the following foods contains the least amount of antioxidant vitamins?

○ carrots

○ walnuts

○ chicken breast

○ lemon

○ wheat germ

○ Don't know/Not sure

X→

67 The part of the food label with nutrition information is called the "Nutrition Facts" panel. How often do you use the Nutrition Facts panel when deciding to buy a food product?

○ Always

○ Most of the time

○ Sometimes

○ Rarely

○ Never

○ I've never seen a "Nutrition Facts" panel on a label

X→

68 How interested are you in buying foods that are "low fat"?

	1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
	○	○	○	○	○	○	○	○	○	○

X→

69 interested are you in buying foods that are "low carb"?

	1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
	○	○	○	○	○	○	○	○	○	○

X→

70 How interested are you in buying foods that are "trans fat free"?

	1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
	○	○	○	○	○	○	○	○	○	○

X→

71 How interested are you in buying foods that are "low in saturated fat"?

1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
○	○	○	○	○	○	○	○	○	○

X→

72 How interested are you in buying foods that are "high in fiber"?

1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
○	○	○	○	○	○	○	○	○	○

X→

73 How interested are you in buying foods that are "low sodium"?

1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
○	○	○	○	○	○	○	○	○	○

X→

74 How interested are you in buying foods that are "fair trade"?

1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
○	○	○	○	○	○	○	○	○	○

X→

75 How interested are you in buying foods that are "certified organic"?

1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
○	○	○	○	○	○	○	○	○	○

X→

76 How interested are you in buying foods that are "locally grown"?

1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
○	○	○	○	○	○	○	○	○	○

X→

77 How interested are you in buying foods that are "non-GMO"?

1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
○	○	○	○	○	○	○	○	○	○

X→

78 How interested are you in buying foods that are "cholesterol free"?

1 Not at all interested	2	3	4	5	6	7	8	9	10 Very interested
○	○	○	○	○	○	○	○	○	○

X→

79 How would you rate the importance of the environmental impacts of your food?

1 Not at all important	2	3	4	5	6	7	8	9	10 Very important
○	○	○	○	○	○	○	○	○	○

X→

80 How would you rate the importance of the treatment of animals involved in the production of your food?

1 Not at all important	2	3	4	5	6	7	8	9	10 Very important
○	○	○	○	○	○	○	○	○	○

X→

81 How would you rate the importance of the working conditions of those who grow, make or sell your food?

1 Not at all important	2	3	4	5	6	7	8	9	10 Very important
○	○	○	○	○	○	○	○	○	○

X→

82 How would you rate the importance that the workers who grew, picked, packaged, processed, transported and/or sold your food receiving a living wage (allowing workers to meet their basic needs like housing, food, clothing and transportation)?

1 Not at all important	2	3	4	5	6	7	8	9	10 Very important
○	○	○	○	○	○	○	○	○	○

End of Block: Part 2 questions from previous hnf 150 survey, not jones survey questions

Start of Block: Part 3 Dietary Screener Questionnaire (DSQ) food frequency

Q4.1 Food Frequency Questions

The following is a FOOD FREQUENCY QUESTIONNAIRE (FFQ) and is designed to ask people about their USUAL DIET. This FFQ has been developed by the National Cancer Institute of the National Institutes of Health and is widely used in nutrition research.

 These questions are about foods you ate or drank **during the past month, that is, in the past 30 days**. When answering, please include meals and snacks at home, at work or school, in restaurants, and anyplace else.

X→

83 How do you identify yourself?

○ Male

○ Female

○ Non-binary/Additional gender category

○ Decline to answer

84 How old are you (in years)?
_____

X→

85 During the past month, how often did you eat hot or cold cereals?

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

X→

86 During the past month, what kind(s) of cereal did you usually eat? For example, Quaker granola, or Corn Pops, etc.

☐   Cereal 1 _____

☐   Cereal 2 _____

☐   Cereal 3 _____

☐   Cereal 4 _____

☐   Cereal 5 _____

X→

87 During the past month, how often did you have any milk (either to drink or on cereal)? Include regular milks, chocolate or other flavored milks, lactose-free milk, buttermilk. Please do not include soy milk or other non-dairy milks, or small amounts of milk in coffee or tea.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2-3 times per day

○ 4-5 times per day

○ 6 or more times per day

X→

222

88 During the past month, what kind of milk did you usually drink?

○ Whole or regular milk

○ 2% fat or reduced-fat milk

○ 1%, ツス%, or low-fat milk

○ Fat-free, skim or nonfat milk

○ Soy milk

○ Others (please specify) _____

X→

89 During the past month, how often did you drink regular soda or pop that contains sugar? Do not include diet soda.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2-3 times per day

○ 4-5 times per day

○ 6 or more times per day

X→

90 During the past month, how often did you drink 100% pure fruit juices such as orange, mango, apple, grape and pineapple juices? Do not include fruit-flavored drinks with added sugar or fruit juice you made at home and added sugar to.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2-3 times per day

○ 4-5 times per day

○ 6 or more times per day

X→

91 During the past month, how often did you drink coffee or tea that had sugar or honey added to it? Include coffee and tea you sweetened yourself and presweetened tea and coffee drinks such as Arizona Iced Tea and Frappuccino. Do not include artificially sweetened coffee or diet tea.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2-3 times per day

○ 4-5 times per day

○ 6 or more times per day

X→

92 During the past month, how often did you drink sweetened fruit drinks, sports or energy drinks, such as Kool-Aid, lemonade, Hi-C, cranberry drink, Gatorade, Red Bull or Vitamin Water? Include fruit juices you made at home and added sugar to. Do not include diet drinks or artificially sweetened drinks.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2-3 times per day

○ 4-5 times per day

○ 6 or more times per day

X→

93 During the past month, how often did you eat fruit? Include fresh, frozen or canned fruit. Do not include juices.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

X→

94 During the past month, how often did you eat a green leafy or lettuce salad, with or without other vegetables? Do not include salads made with spinach.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

X→

95 During the past month, how often did you eat any kind of fried potatoes, including French fries, home fries, or hash brown potatoes?

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

X→

96 During the past month, how often did you eat any other kind of potatoes, such as baked, boiled, mashed potatoes, sweet potatoes, or potato salad?

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

X→

97 During the past month, how often did you eat refried beans, baked beans, beans in soup, pork and beans or any other type of cooked dried beans? Do not include green beans.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

X→

98 During the past month, how often did you eat brown rice or other cooked whole grains, such as bulgur, cracked wheat, or millet? Do not include white rice.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

X→

99 During the past month, not including what you just told me about (green salads, potatoes, cooked dried beans), how often did you eat other vegetables?

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

X→

100 During the past month, how often did you have Mexican-type salsa made with tomato?

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

X→

101 During the past month, how often did you eat pizza? Include frozen pizza, fast food pizza, and homemade pizza.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

X→

102 During the past month, how often did you have tomato sauces such as with spaghetti or noodles or mixed into foods such as lasagna? Do not include tomato sauce on pizza.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

X→

103 During the past month, how often did you eat any kind of cheese? Include cheese as a snack, cheese on burgers, sandwiches, and cheese in foods such as lasagna, quesadillas, or casseroles. Do not include cheese on pizza.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

X→

231

104 During the past month, how often did you eat red meat, such as beef, pork, ham, or sausage? Do not include chicken, turkey or seafood. Include red meat you had in sandwiches, lasagna, stew, and other mixtures. Red meats may also include veal, lamb, and any lunch meats made with these meats.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

X→

105 During the past month, how often did you eat any processed meat, such as bacon, lunch meats, or hot dogs? Include processed meats you had in sandwiches, soups, pizza, casseroles, and other mixtures.
Processed meats are those preserved by smoking, curing, or salting, or by the addition of preservatives. Examples are: ham, bacon, pastrami, salami, sausages, bratwursts, frankfurters, hot dogs, and spam.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

X→

106 During the past month, how often did you eat whole grain bread including toast, rolls and in sandwiches? Whole grain breads include whole wheat, rye, oatmeal and pumpernickel. Do not include white bread.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

X→

107 During the past month, how often did you eat chocolate or any other types of candy? Do not include sugar-free candy.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

X→

108 During the past month, how often did you eat doughnuts, sweet rolls, Danish, muffins, pan dulce, or pop-tarts? Do not include sugar-free items.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

X→

109 During the past month, how often did you eat cookies, cake, pie or brownies? Do not include sugar-free kinds.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

X→

110 During the past month, how often did you eat ice cream or other frozen desserts? Do not include sugar-free kinds.

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

X→

111 During the past month, how often did you eat popcorn?

○ Never

○ 1 time last month

○ 2-3 times last month

○ 1 time per week

○ 2 times per week

○ 3-4 times per week

○ 5-6 times per week

○ 1 time per day

○ 2 or more times per day

End of Block: Part 3 Dietary Screener Questionnaire (DSQ) food frequency

Start of Block: Part 4 Extending learning to family friends

Q5.1 Extending Learning to Your Family and/or Friends

Dr. Alaimo often hears from students that they share information from the class with their families, friends and others. Students who take the course can be important ambassadors to help spread the word about the importance of

nutrition and how it can keep us healthy, especially now! We are interested in learning if you shared any of the information you learned in HNF150 with others, what you shared, and how.

X→

116 Did you share any of the information you learned in HNF150 with anyone?

○ Yes

○ No

X→

117 Who was the person(s) you shared HNF150 information with? Mark all that apply.

☐ Does not apply, I did not share information with anyone

☐ Friend/acquaintance

☐ Parent/guardian

☐ Grandparent

☐ Sibling

☐ Co-worker

☐ Other (please specify) _____

X→

118 How did you share the information you learned in HNF150 with someone? Mark all that apply.

○ Does not apply, I did not share information with anyone

○ Conversation

○ Text

○ Email

○ Instagram or other social media

○ While cooking

○ While eating

○ Other (please specify) _____

X→

119 If you did share information, what kinds of information did you share? Mark all that apply. If you did not share information, select "N/A".

☐ Eating more healthfully/mindfully

☐ Interesting facts about nutrients

☐ Information about foods and/or food groups

☐ Nutrient deficiency prevention

☐ Chronic disease prevention

☐ Sustainability

☐ Hunger and food insecurity

☐ Nutrition during pregnancy, infants and children

☐ Sports nutrition

☐ Food industry practices

☐ All aspects of the class

☐ Not Applicable "N/A"– I did not share information

☐ Other _____

Q6.1 These next questions ask about any changes in nutrition knowledge and behaviors as a result of completing the Pea Pod Discussion assignments and creating the "Pea Pod Nutrition" videos.

Q6.2 In comparison to before you completed the Pea Pod assignments and videos, after completing the assignments and videos, for each of the following questions and each statement listed, select the answer that best indicates how much you personally agree or disagree with that statement. Use the scale of Strongly agree to Strongly disagree. If you don't understand a statement or don't have an opinion, please select "Does Not Apply".

120
After completing the Pea Pod assignments and videos, I know more about the health benefits of eating....

	Strongly agree	agree	Neither agree nor disagree	disagree	Strongly disagree	Does not apply
Unprocessed whole plants foods	○	○	○	○	○	○
Green leafy vegetables, like spinach, romaine lettuce, and kale	○	○	○	○	○	○
Whole grains, like whole wheat bread, oatmeal, and brown rice	○	○	○	○	○	○
Legumes like chickpeas, black beans, and peanuts	○	○	○	○	○	○
Dark orange/yellow/red fruit and vegetables, like red peppers, apricots, and sweet potatoes	○	○	○	○	○	○
Raw nuts and seeds, like almonds, walnuts, and sunflower seeds	○	○	○	○	○	○

121 After completing the Pea Pod assignments and videos, I am more familiar with….

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Does not apply
Unprocessed whole plants foods	○	○	○	○	○	○
Green leafy vegetables, like spinach, romaine lettuce, and kale	○	○	○	○	○	○
Whole grains, like whole wheat bread, oatmeal, and brown rice	○	○	○	○	○	○
Legumes like chickpeas, black beans, and peanuts	○	○	○	○	○	○
Dark orange/yellow/red fruit and vegetables, like red peppers, apricots, and sweet potatoes	○	○	○	○	○	○
Raw nuts and seeds, like almonds, walnuts, and sunflower seeds	○	○	○	○	○	○

X→

122 After completing the Pea Pod assignments and videos, I am better able to prepare or cook…

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Does not apply
Unprocessed whole plants foods	◯	◯	◯	◯	◯	◯
Green leafy vegetables, like spinach, romaine lettuce, and kale	◯	◯	◯	◯	◯	◯
Whole grains, like whole wheat bread, oatmeal, and brown rice	◯	◯	◯	◯	◯	◯
Legumes like chickpeas, black beans, and peanuts	◯	◯	◯	◯	◯	◯
Dark orange/yellow/red fruit and vegetables, like red peppers, apricots, and sweet potatoes	◯	◯	◯	◯	◯	◯
Raw nuts and seeds, like almonds, walnuts, and sunflower seeds	◯	◯	◯	◯	◯	◯

X→

123 After completing the Pea Pod assignments and videos, I have more skills to eat…

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Does not apply
Unprocessed whole plants foods	○	○	○	○	○	○
Green leafy vegetables, like spinach, romaine lettuce, and kale	○	○	○	○	○	○
Whole grains, like whole wheat bread, oatmeal, and brown rice	○	○	○	○	○	○
Legumes like chickpeas, black beans, and peanuts	○	○	○	○	○	○
Dark orange/yellow/red fruit and vegetables, like red peppers, apricots, and sweet potatoes	○	○	○	○	○	○
Raw nuts and seeds, like almonds, walnuts, and sunflower seeds	○	○	○	○	○	○

X→

124 After completing the Pea Pod assignments and videos, I have more confidence in my ability to eat…

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Does not apply
Unprocessed whole plants foods	○	○	○	○	○	○
Green leafy vegetables, like spinach, romaine lettuce, and kale	○	○	○	○	○	○
Whole grains, like whole wheat bread, oatmeal, and brown rice	○	○	○	○	○	○
Legumes like chickpeas, black beans, and peanuts	○	○	○	○	○	○
Dark orange/yellow/red fruit and vegetables, like red peppers, apricots, and sweet potatoes	○	○	○	○	○	○
Raw nuts and seeds, like almonds, walnuts, and sunflower seeds	○	○	○	○	○	○

X→

125 After completing the Pea Pod assignments and videos, I am more motivated to eat...

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Does not apply
Unprocessed whole plants foods	○	○	○	○	○	○
Green leafy vegetables, like spinach, romaine lettuce, and kale	○	○	○	○	○	○
Whole grains, like whole wheat bread, oatmeal, and brown rice	○	○	○	○	○	○
Legumes like chickpeas, black beans, and peanuts	○	○	○	○	○	○
Dark orange/yellow/red fruit and vegetables, like red peppers, apricots, and sweet potatoes	○	○	○	○	○	○
Raw nuts and seeds, like almonds, walnuts, and sunflower seeds	○	○	○	○	○	○

X→

126 After completing the Pea Pod assignments and videos, I am eating more…

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Does not apply
Unprocessed whole plants foods	○	○	○	○	○	○
Green leafy vegetables, like spinach, romaine lettuce, and kale	○	○	○	○	○	○
Whole grains, like whole wheat bread, oatmeal, and brown rice	○	○	○	○	○	○
Legumes like chickpeas, black beans, and peanuts	○	○	○	○	○	○
Dark orange/yellow/red fruit and vegetables, like red peppers, apricots, and sweet potatoes	○	○	○	○	○	○
Raw nuts and seeds, like almonds, walnuts, and sunflower seeds	○	○	○	○	○	○

127 If you made any changes to how you prepare and eat foods as a result of completing the peapod assignment and video(s), please describe those changes in the space provided.

_____
_____
_____
_____
_____

X→

128
For each statement listed, select the answer that best indicates how much you personally agree or disagree with that

statement. Use the scale of Strongly Disagree to Strongly Agree.

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Does not apply
I enjoy trying new foods	○	○	○	○	○	○
My family or friends encourage me to eat fruits and vegetables	○	○	○	○	○	○
My family or friends remind me not to eat junk food	○	○	○	○	○	○
My family or friends would say something to me if they saw I was not eating fruits and vegetables	○	○	○	○	○	○
I eat enough fruits and vegetables to keep me healthy	○	○	○	○	○	○

X→

129 In comparison to before you completed the Pea Pod assignments and videos, after completing the assignment and video(s), are these statements more true, neither more or less true, or less true for you?

	More True	Neither more tor less true	Less true	Does not apply
I enjoy trying new foods	○	○	○	○
My family or friends encourage me to eat fruits and vegetables	○	○	○	○
My family or friends remind me not to eat junk food	○	○	○	○
My family or friends would say something to me if they saw I was not eating fruits and vegetables	○	○	○	○
I eat enough fruits and vegetables to keep me healthy	○	○	○	○

X→

130
For each statement listed, select the answer that best indicates how much you personally agree or disagree with the statement. The term, "whole plant foods" refers to unprocessed fruit, vegetables, whole grains, beans and raw nuts

and seeds. Use the scale of Strongly Disagree to Strongly Agree.

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Does not apply
Whole plant foods taste good	○	○	○	○	○	○
Whole plant foods cost too much	○	○	○	○	○	○
Whole plant foods are difficult to prepare	○	○	○	○	○	○
Whole plant foods are difficult to find at a store	○	○	○	○	○	○
The stores where I shop sell a variety of whole plant foods	○	○	○	○	○	○
Whole plant foods are convenient to eat	○	○	○	○	○	○
My family wants to eat whole plant foods	○	○	○	○	○	○
I would buy whole plant foods if I knew they were healthful	○	○	○	○	○	○
I would buy a food that took longer to prepare if I knew it was healthier	○	○	○	○	○	○

X→

131 Thinking about yourself, if you were to eat plenty of whole plant foods every day, how likely would you be to. . .

	Very likely	Likely	Neutral	Not Likely	Very unlikely	Does not apply
Have more energy	○	○	○	○	○	○
Live a long life	○	○	○	○	○	○
Look better (appearance)	○	○	○	○	○	○
Be "regular" (have regular bowel movements)	○	○	○	○	○	○
Feel good about yourself	○	○	○	○	○	○

End of Block: Part 5 Change in Knowledge, Skills, Confidence, Motivation, and Consumption

Start of Block: Part 6 Final questions - course style preference and NetID

X→

132 Now that you have completed the Dietary Assessment Assignment, how helpful was it to your learning?

○ Extremely helpful

○ Very helpful

○ Somewhat helpful

○ Not so helpful

○ Not at all helpful

----

133 Please comment on your response. Which aspects of the Dietary Assessment Assignment were most beneficial to you? Do you have any suggestions for improvement?

_____

----

115 **What is your <u>Net ID</u>?**

This is what comes before the @msu.edu in your MSU email address. Be sure to spell it correctly to receive credit. We use your NetID in order to upload your credit for this assignment into the D2L gradebook.

Please do **<u>NOT</u>** give us your APID or student ID number -- this causes us a lot of difficulties when

uploading your points into the D2L gradebook.

Thank you for taking the time to complete this survey.

_____

APPENDIX G - JONES NUTRITION KNOWLEDGE SURVEY

This questionnaire is so we can get an idea how familiar people are with nutrition. This is a survey, not a test. Your answers will help us identify what nutrition advice people find confusing. For each question, please use a pen or pencil to mark an ☒ or ☑ for the answer that fits you best.

- It is important that you complete it without the help of others.
- If you don't know the answer, please mark "not sure" rather than guess or look up the answer.

These next items are about what advice about nutrition you think experts are giving.
(Please choose only one answer for each.)

1. Which <u>one</u> of these is the current government food guide?

   ☐

   ☐

   ☐

   ☐ Not sure

2. How well would you say you know the government's food guide, called MyPlate?
   - ☐ Never heard of it
   - ☐ Heard of, but know very little about it
   - ☐ Know some about it
   - ☐ Know a lot about it

3. How much would you say you know about whole grains?
   - ☐ Never heard of them
   - ☐ Heard of, but know very little about them
   - ☐ Know some about them
   - ☐ Know a lot about them

4. As far as you know, what are whole grains?
   - ☐ Grains that still have the bran and germ
   - ☐ Milled grains
   - ☐ Anything with added fiber
   - ☐ Refined flour
   - ☐ Not sure

5. Based on what you know, which of these isn't usually a whole grain?
   - ☐ Popcorn
   - ☐ Oatmeal
   - ☐ Flour tortillas
   - ☐ Brown rice
   - ☐ Not sure

6. Based on what you know, grains are an important source of...
   - ☐ Vitamin D
   - ☐ Vitamin K
   - ☐ B vitamins
   - ☐ Vitamin C
   - ☐ Not sure

7. As far as you know, which of these should you look for on a label to tell if a loaf of bread is whole wheat?
   - ☐ 100% wheat
   - ☐ Stone-ground wheat
   - ☐ Cracked wheat
   - ☐ Whole wheat is first in the ingredient list
   - ☐ Not sure

8. As far as you know, what amount of cooked vegetables is generally considered a serving?
   - ☐ ¼ cup
   - ☐ ½ cup
   - ☐ 1 cup
   - ☐ 2 cups
   - ☐ Not sure

9. Based on what you know, what is the amount of vegetables MyPlate (the government's food guide) recommends an adult should eat?
   - ☐ 1 to 2 cups each day
   - ☐ 2 to 3 cups each day
   - ☐ 6 to 7 cups each day
   - ☐ 5 to 6 cups each week
   - ☐ Not sure

10. Based on what you know, why does MyPlate (the government's food guide) recommend people eat a variety of vegetables?
    - ☐ To increase protein intake
    - ☐ Helps you get all your nutrients
    - ☐ It's better for the environment
    - ☐ To save money
    - ☐ Not sure

11. Based on what you know, fruit is an important source of which of these nutrients?
- ☐ Protein
- ☐ Vitamin C
- ☐ Calcium
- ☐ Vitamin B12
- ☐ Not sure

12. Based on what you know, what type of dairy (milk, cheese, yogurt, etc) does MyPlate recommend?
- ☐ None
- ☐ Whole milk
- ☐ Low fat and fat free
- ☐ A mix of low fat and full fat
- ☐ Not sure

13. Based on what you know, which of the following are some calcium-rich alternatives to milk?
- ☐ Calcium-fortified juice
- ☐ Canned fish with bones (such as sardines)
- ☐ Kale and collard greens
- ☐ All of the above
- ☐ Not sure

14. Why do you think MyPlate recommends eating low-fat and lean meat and poultry?
- ☐ They have more vitamins
- ☐ To keep saturated fat low
- ☐ To save money
- ☐ They have more fiber
- ☐ Not sure

15. Based on what you know, which of these is a safe way to defrost meat?
- ☐ On the kitchen counter
- ☐ In a bowl of hot water
- ☐ In the oven
- ☐ In the refrigerator
- ☐ Not sure

16. Do you agree that some foods can be high in fat but not cholesterol?
- ☐ Agree
- ☐ Disagree
- ☐ Not sure

17. How would you rate the healthfulness of each of the following types of fat?

	Healthy	Un-healthy	Not sure
a. Polyunsaturated fats	☐	☐	☐
b. Monounsaturated fats	☐	☐	☐
c. Saturated fats	☐	☐	☐
d. Omega-3 fats	☐	☐	☐
e. *Trans* fats	☐	☐	☐

18. As far as you know, how are oils like olive and canola oil different from solid fats like butter and shortening?
- ☐ Oils are usually lower in saturated fat
- ☐ Oils raise LDL (bad) cholesterol
- ☐ Oils are usually higher in saturated fat
- ☐ Oils are always hydrogenated
- ☐ Not sure

19. As far as you know, which fat do experts say is <u>most</u> important for people to eat less of?
- ☐ Monounsaturated fat
- ☐ Polyunsaturated fat
- ☐ Saturated fat
- ☐ *Trans* fat
- ☐ Not sure

These next few items are about the nutrients in foods. *(Please choose only one answer for each.)*

1. Do you agree that sunlight helps the body produce vitamin D naturally?
- ☐ Agree
- ☐ Disagree
- ☐ Not sure

2. As far as you know, which of the following has the most calories?
- ☐ 1 gram of sugar
- ☐ 1 gram of protein
- ☐ 1 gram of fiber
- ☐ 1 gram of fat
- ☐ Not sure

3. Do you agree that brown sugar is a healthier choice than white sugar?
- ☐ Agree
- ☐ Disagree
- ☐ Not sure

4. Do you think these are high or low in salt when they are cooked without added salt?

	High	Low	Not sure
a. Cheese	☑	☐	☐
b. Pasta without sauce	☐	☑	☐
c. Red meat	☐	☑	☐

5. Do you think these are high or low in fiber?

	High	Low	Not sure
a. Fish	☐	☑	☐
b. Raspberries	☑	☐	☐
c. Eggs	☐	☑	☐
d. Red meat	☐	☑	☐
e. Broccoli	☑	☐	☐
f. Baked potato with skin	☑	☐	☐

6. Do you think these foods are high or low in saturated fat when cooked without adding fat?

	High	Low	Not sure
a. Fish sticks	☑	☐	☐
b. Whole milk	☑	☐	☐
c. Olive oil	☐	☑	☐
d. Red meat	☑	☐	☐
e. Chocolate	☑	☐	☐

7. A type of oil which contains mostly monounsaturated fat is...
☐ Coconut oil
☐ Soybean oil
☐ Olive oil
☐ Palm oil
☐ Not sure

8. Based on what you know, which has more fat per serving?
☐ Hot dogs
☐ Ham
☐ They both have the same
☐ Not sure

9. Based on what you know, which has more fat per serving?
☐ Peanuts
☐ Air-popped popcorn
☐ They both have the same
☐ Not sure

10. As far as you know, cholesterol is found in...
☐ Vegetables and vegetable oils
☐ Animal products like meat and dairy products
☐ All foods that have fat or oil
☐ Not sure

11. As far as you know, if a product is labeled as only containing vegetable oil, it is...
☐ Low in saturated fat
☐ High in saturated fat
☐ Could be either high or low in saturated fat
☐ Not sure

12. Would you consider 100 milligrams of sodium to be a low or high amount for one serving of food?
☐ Low
☐ High
☐ Not sure

13. Would you consider 20 grams of fat to be a low or high amount for one serving of food?
☐ Low
☐ High
☐ Not sure

14. Would you consider 5 grams of fiber to be a low or high amount for one serving of food?
☐ Low
☐ High
☐ Not sure

15. Would you consider 10 grams of saturated fat to be a low or high amount for one serving of food?
☐ Low
☐ High
☐ Not sure

This next section is about health benefits of foods. *(Please choose only one answer for each.)*

1. **Are you aware of any major diseases that eating enough fruit and vegetables might help prevent?**
   - ☐ Yes
   - ☐ No
   - ☐ Not sure

   If Yes, what major diseases does eating enough fruit and vegetables help prevent?
   Correct only if they list a health problem in which fruit/vegetable intake has a preventative effect, such as CVD, cancer, scurvy

2. **Are you aware of any major diseases that eating enough fiber might help prevent?**
   - ☐ Yes
   - ☐ No
   - ☐ Not sure

   If Yes, what major diseases does eating enough fiber help prevent?
   Correct only if they list a health problem related to fiber intake, such as diverticulitis or colon cancer.

3. **Are you aware of any major health problems or diseases that are related to how much salt people eat?**
   - ☐ Yes
   - ☐ No
   - ☐ Not sure

   If Yes, what diseases or health problems do you think are related to salt?
   Correct only if they list a health problem related to salt intake, such as hypertension or CVD

4. **Do you think these help protect against certain kinds of cancer?** *(Please choose only one answer for each.)*

	Yes	No	Not sure
a. Eating more fiber	☐	☐	☐
b. Eating less salt	☐	☐	☐
c. Eating more red meat	☐	☐	☐

5. **Do you think these help protect against heart disease?**

	Yes	No	Not sure
a. Eating more fiber	☐	☐	☐
b. Eating more red meat	☐	☐	☐

6. **Neural tube defects are birth defects of the brain and spinal cord. Can eating any of these vitamins in early pregnancy help prevent these kinds of birth defects?**
   - ☐ Vitamin A
   - ☐ Folic acid or folate
   - ☐ Vitamin D
   - ☐ None of these
   - ☐ Not sure

7. **Which of the following statements about exercise and cancer do you agree with?**
   - ☐ Exercise increases chances of some types of cancer
   - ☐ Exercise decreases chances of some types of cancer
   - ☐ Exercise makes no difference
   - ☐ Not sure

8. **Which of the following statements about calories and weight gain do you agree with?**
   - ☐ Calories from fats are most likely to cause weight gain
   - ☐ All calories cause the same weight gain
   - ☐ Calories from carbohydrates are most likely to cause weight gain
   - ☐ None of these
   - ☐ Not sure

Now we'd like you to tell us a little about yourself.

1. **Do you follow a special diet, and/or have dietary restrictions?** (examples: diabetic, low-sodium, gluten-free, kosher, vegan, lactose-free, etc.)
   - ☐ Yes – What is it? _____
   - ☐ No

2. **In what year were you born?**

   ____

3. **What is your gender?**
   - ☐ Male
   - ☐ Female

4. **Do you have any health or nutrition-related qualifications, degrees or certifications, etc?**
   - ☐ Yes – What are they? _____

   _____
   - ☐ No

5. **What is your current job status?**
   (Please choose the one that best applies.)
   - ☐ Employed
   - ☐ Unemployed
   - ☐ Homemaker
   - ☐ Student
   - ☐ Retired
   - ☐ Disabled
   - ☐ Something else – What is it?

   _____

6. **What is the highest grade or level of school you have finished?** *(Please choose only one.)*
   - ☐ Less than 8th grade
   - ☐ 8th through 11th grade
   - ☐ Finished high school or have GED
   - ☐ Vocational or technical training
   - ☐ Some college
   - ☐ Associate's degree
   - ☐ Bachelor's degree
   - ☐ Postgraduate

7. **Which one or more of the following would you say is your background?**
   (Please choose all that apply.)
   - ☐ Native American or Alaska Native
   - ☐ Asian or Asian American
   - ☐ Black/African American
   - ☐ Hispanic or Latino
   - ☐ Native Hawaiian or other Pacific Islander
   - ☐ White/Caucasian
   - ☐ Something else – What is it?

   _____

8. **What is your annual income, meaning all the income from all sources earned last year by family members living in your home?**
   (Please choose only one.)
   - ☐ $0-$19,999
   - ☐ $20,000-$39,999
   - ☐ $40,000-$59,999
   - ☐ $60,000-$79,999
   - ☐ $79,000-$99,999
   - ☐ $100,000 or more

Thank you!

Your help with this survey is greatly appreciated.

If you have any questions about this study please call _____, or email _____.

If you have any additional comments or anything else you'd like to tell us, please feel free to use this space or the next page.