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UNDERSTANDING FOOD LITERACY AND ITS USE IN A TECHNOLOGY-DRIVEN NUTRITION EDUCATION PROGRAM FOR ADOLESCENTS.

Catherine A. Wickham
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**UNDERSTANDING FOOD LITERACY AND ITS USE IN A TECHNOLOGY-DRIVEN
NUTRITION EDUCATION PROGRAM FOR ADOLESCENTS.**

A Dissertation Presented

by

CATHERINE A. WICKHAM

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
of the requirements for the degree of

DOCTOR OF PHILOSOPHY

SEPTEMBER 2017

School of Public Health and Health Sciences
Department of Nutrition

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Finally, to my family who have so patiently waited, a poem of thanks entitled A Doctoral Dissertation.

A long time ago I started this process
Although time and money have really drained my pocket
Your love and support through all phases of doubt
Always picked me up and you all knew somehow it would work out!

To my niece who often calls me the food police
I know I've been grumpy and told you to go play
But now that I'm done and time's not in the way
Let's get creative and bake
Who knows you just might like vegetable cake!

To Chrissy and Rob who helped me through, a literal move or two
Sorry, but I'm done so no more Maggie pickup for you!

To my Aunt Pat and Uncle Paul who I admire so much
You knew I could, even when I had reservations
And your advice pushed me forward without hesitation!

To my Mom and Dad what can I say
Two greater people just aren't made
And to answer the question you have asked me **more** than a time or two

When will I be through?
Well, just keep reading it's in 230 pages give or take a few!

ABSTRACT

UNDERSTANDING FOOD LITERACY AND ITS USE IN A TECHNOLOGY-DRIVEN NUTRITION EDUCATION PROGRAM FOR ADOLESCENTS

SEPTEMBER 2017

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Directed by: Associate Professor Elena T. Carbone

One in three adolescents in the U.S. is overweight or obese. The dietary habits of this population are concerning as few meet current dietary recommendations for consuming fruits and vegetables. Equally troubling among this group is the consumption of sugar-sweetened beverages and the lack of physical activity. Studies that investigate the link between nutrition knowledge, attitudes, and behaviors have shown mixed results and new methods to investigate this relationship are needed. Food literacy is a new term that has risen out of the health and nutrition literacy fields. Food literacy seeks to examine the complex relationship between knowledge, attitudes, and behaviors from the perspective of food and not individual nutrients. Adolescence is a unique life stage when there is development of decision-making skills. Food literacy programs are ideally suited to this stage because the concept focuses on building capacity to operationalize healthy decisions regarding food. New methods are also needed, to help increase engagement and participation in food-related programs. Adolescents are digital natives. Eighty-seven percent have access to a computer, 88% have access to a cellphone, and 92% go online daily, from these devices. Driving the use of cellphones is social media and text

messaging. In fact, 91% of adolescents use their cellphone for texting, sending an average of 67 messages/day. Adolescent's pervasive use of technology, in particular cellphones, provides an opportunity to investigate the potential of this medium to engage participants in education about food. Another novel method to engage adolescents in food-related education is the use of community-based participatory research (CBPR). CBPR is a collaborative approach that includes community members in the research process. The approach incorporates sharing of ideas between community members and researchers, values mutual decision-making, and empowers participants to plan activities and make changes they see as beneficial to their community. CBPR is not often used with adolescents, and no current research has used CBPR to inform a technology-driven, food literacy program for low-income, ethnically diverse adolescents. Filling this gap will add to the understanding of the use of innovative programs and ideas to engage adolescents and help them develop healthy eating behaviors.

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CHAPTER 1

INTRODUCTION

Over two-thirds of the adult population is overweight or obese, and the number of overweight and obese adolescents is increasing.¹ Dietary behaviors and physical activity have become a focus of attention to reverse this trend. Adolescents are consuming far fewer healthy foods such as fruits and vegetables and more foods such as sugar-sweetened beverages.^{2,3} Also, adolescents are not meeting the current recommendations for physical activity.⁴ Traditional nutrition education and weight loss programs have had little impact on moving participants to healthy dietary behaviors. Therefore, it is time to take a step back to gain a better perspective on how people interact with food at the most basic level.

Often, literacy is thought of in an educational setting as the foundation on which other skills and learning opportunities develop. In recent years, research has focused on the importance of health and nutrition literacy as a means to navigate the complex health and nutrition environments.^{5,6} Emerging from health/nutrition literacy is a new concept – food literacy. Food literacy (FL) is the foundation on which individuals can build a healthy relationship with food.⁷ Adolescence is a distinct lifecycle stage regarding both maturation and cognitive development.^{8,9} During this time youth are acquiring and testing decision-making skills^{8,10,11} and as such, it is the ideal time in which to integrate a FL program in an effort to build life-long healthy behaviors. However, motivating adolescents to participate in a FL program may require innovative methods.

Technology is ubiquitous and adolescents are the most digitally-driven segment of the population.¹² The field of nutrition has started to examine the role of technology as an

influencing factor for dietary change. Computer or website use has been the most widely studied, but recently literature has begun to emerge regarding the use of cellphones.¹³⁻¹⁵ The driving force of change in the technology landscape is the use of social media and texting. These popular features of mobile technology allow people to connect with others around the block or around the world. Developing a technology-driven, FL program is an innovative concept that may appeal to adolescents. However, additional methods are needed to develop generationally appropriate programs and materials.

Community-Based Participatory Research (CBPR) is a process by which community stakeholders work with researchers to identify key needs and develop programs that are more pertinent to their lives and communities.¹⁶⁻¹⁸ Though not widely used with adolescents, CBPR is a best practice that engages participants in the research process. This engagement helps develop meaningful programs for all involved.

CHAPTER 2

LITERATURE REVIEW

2.1 Diet Quality

2.1.1 Current Trends

Over the last 35 years, obesity in adults has more than doubled.¹ In this same period, obesity in adolescents has quadrupled.¹ There is some evidence that obesity has decreased in young children 2-5 years-old¹⁹; however, currently over 75% of adults²⁰ and one-third of adolescents²¹ are overweight or obese. This increase in overweight/obesity is a concern for the health and well-being of the population as children and adolescents who are overweight are more likely to be overweight as adults.²²⁻²⁴ There are also long-term health implications that arise from child and adolescent overweight/obesity as the condition is associated with increased risk of morbidity (type II diabetes, heart disease, hypertension, and stroke) in adulthood.²⁵

Despite a plethora of nutrition-related recommendations, the population, in general, has difficulty putting these recommendations into action and creating lasting behavioral changes. Recent reports indicate that 76% of adults do not meet the current recommendations for 1 ½ - 2 cups of fruits daily and 87% do not meet the current recommendations for 2-3 cups of vegetables.²⁶ Among adolescents, consumption of fruits and vegetables is equally troubling, as the median number of times per day (a proxy for servings) that fruits and vegetables are consumed is just 1.0 and 1.3, respectively, which is far below the recommended amount.³

The consumption of sugar-sweetened beverages (SSB) is a primary source of added sugar in the diets of Americans and has been identified as a contributing factor to

overweight/obesity.^{27,28} The American Heart Association has recommended reducing the consumption of added sugar to no more than 100 to 150 (24-36 grams) kcals per day for adults and less than 100 kcals (25 grams) per day for children and adolescents 2-18 years-old.^{29,30} The annual U.S. per capita consumption of soda is approximately 650 eight-ounce cans of soda³¹ (40.63 gallons) -- the equivalent of 4225 teaspoons or over 37 pounds of sugar per year.^{32,33} In comparison, global estimates of soft drink consumption are only 11.4 gallons per person.³³ Although overall U.S. soda consumption is declining (84 kcals/day in adolescents and 45 kcals/day in adults from 1999-2010 totals), adolescents 12-19 years-old drink more sugary beverages than any other age group (155 kcal/day vs. 151 kcal/day, respectively).² Calories from SSB also account for a larger portion of overall energy intake in adolescents (10.4%) vs. adults (6.9%).^{2,34} Nationally one in four adolescents reports drinking at least one soda each day and nearly 70% report drinking one or more sugar-sweetened beverage daily.³⁵

Not only are the dietary habits of adolescents troubling, but lack of physical activity is also a concern. Current recommendations indicate that adolescents should participate in at least 60 minutes or more of physical activity each day.⁴ Adolescents are not meeting these recommendations, and according to the 2013 Youth Risk Behavior Surveillance Survey, only 27.1% of high school students reported participating in 60 minutes of physical activity each day.^{4,36} Gender differences are also apparent with only 17.7% of females and 36.6% of males meeting the daily recommendations for physical activity.

2.1.2 The Role of Dietary Knowledge, Attitudes, and Behaviors

Adequate nutrition and physical activity are important factors to help adolescents achieve optimal growth and maturation.^{9,37,38} Also, proper nutrition and physical activity are essential to reduce the risk of chronic diseases such as obesity, type II diabetes, and heart disease.^{37,38} However, adolescents are consuming too few fruits and vegetables, too many sugar-sweetened beverages, and participating in too little physical activity.^{9,37} While social determinants such as socioeconomic status, education, health and access to healthcare, housing, and neighborhoods set the stage for health and well-being,³⁹ the role that food knowledge and related food skills play in eating behaviors -- particularly for adolescents who are learning and testing foundational lifestyle skills -- is less well known.

The relationship between nutrition knowledge and behaviors is difficult to define, and the literature on this topic has been inconsistent at best.^{40,41} In some instances, studies showed an association between higher nutrition knowledge and better dietary practices such as higher fruit⁴²⁻⁵⁰ or vegetable intake.^{42-45,47-50} In other research, there were no significant relationships,⁵¹⁻⁵⁶ and in still others, correlations were found for nutrition knowledge and demographic factors such as age,⁵⁷⁻⁶⁰ gender,^{58,59} educational level,⁶¹⁻⁶⁵ but not better dietary practices.⁴¹ Often a person has factual (declarative) knowledge but does not have procedural knowledge⁴³ (i.e., knowledge to put facts into action). For example, at a basic level, a person may know that vitamin C is an important vitamin, but he or she may not know what foods provide vitamin C, or how to cook these foods to maximize retention of the vitamin. Also, self-efficacy, the confidence in one's ability to perform a task⁶⁶ may or may not be present. It is a potential disconnect between the two

forms of knowledge (declarative and procedural) and the concept of self-efficacy that offers an explanation of how knowledge does not necessarily translate into practice.^{40,41} The association between nutrition knowledge and eating behaviors in adolescents is not well understood,^{67,68} yet unhealthy eating behaviors are often cited as contributing factors to the growing prevalence of obesity. Therefore, understanding the relationship between nutrition knowledge, attitudes toward healthy foods, and health-promoting behaviors is crucial to help tip the scale of overweight and obesity in the right direction.

2.1.3 Dietary Studies – Cross-Sectional

A cross-sectional study by Beech et al⁶⁹ assessed the relationship between knowledge, attitudes and eating practices related to fruits and vegetables among 2213 adolescents, 56% female, 84% white. Fewer than 40% of respondents answered knowledge questions correctly, and only 9% indicated they consumed the recommended 5-6 servings of fruits and vegetables each day. Despite lower knowledge and fruit and vegetable consumption levels, participants had a medium to high level of self-efficacy in their ability to eat fruits and vegetables.⁶⁹ This study was descriptive and focused on correlations between knowledge and attitudes and knowledge, attitudes, and behaviors; however, direct measurement of consumption was not carried out. Also, this study relied on self-reported responses, which can result in responder bias. Social desirability (providing answers that one thinks are socially acceptable or similar to what others might think) is a concern with using self-reported surveys.^{70,71}

Similarly, a 2001 cross-sectional study found nutrition knowledge and healthy eating behavior scores to be low for a group of 532 (54% female), 10-13 year-olds (Grades 6-8).⁴⁰ On a self-report questionnaire 69% of 6th graders answered nutrition

knowledge questions correctly and only 47% and 46% of 7th and 8th-grade students respectively, answered these questions correctly. There was no correlation between nutrition knowledge and eating behavior in male or female 6th-grade students or male 7th- and 8th-grade students. There was, however, a significant correlation ($P < .006$) between knowledge and eating behaviors for girls in the 7th and 8th-grade.⁴⁰ Regarding knowledge and behaviors, findings of this study were similar to those in Beech et al; however, differences were reported based on gender. This is an important outcome that needs further research as programs may need to offer components that will engage both males and females.

In another study of nutrition knowledge and behaviors, 117 high school students (17-19 years-old, 62% female) were asked to complete a self-reported questionnaire.⁷² Dietary knowledge was low, with only 73% showing an understanding of nutrition terms, 63% understanding sources of food, and 57% understanding connections between diet and disease. Consumption varied by gender with fewer boys reporting daily consumption of fruits (67.4%) and vegetables (54.5%) as compared to girls (80% fruits and vegetables). Girls consumed more sweets on a daily basis than boys 76.4% vs. 52.3%, respectively while boys consumed more soft drinks than girls 47.7% vs. 36.1%, respectively. Television was the primary source of food and nutrition information, but close to half (48.8% boys and 53.5% girls) reported getting information from the Internet.⁷² Participants in this study showed a low level of nutrition knowledge and in particular a lack of understanding regarding the connection between diet and disease. Adolescents may have difficulty thinking about the future and how actions today will affect future outcomes.³⁸ Using a media outlet that adolescents feel comfortable with (i.e.,

the Internet) to deliver nutrition education has potential to increase nutrition knowledge and ultimately move participants toward behavior change.⁷³ As with the previous study, researchers here observed gender differences; however, this time the differences were in consumption patterns. More research is needed to comprehend what impact gender differences have on nutrition knowledge and consumption patterns.

While nutrition knowledge and eating behaviors are necessary to understand, physical activity and self-efficacy for health-related behaviors are additional variables that have a role in overweight/obesity. A recent study investigated the nutrition knowledge, eating behaviors, physical activity, and self-efficacy of adolescents in a nationwide sample in South Korea.⁷⁴ Participants (N=3531, mean age 10.7, 51.6% female) were classified by BMI as normal weight or overweight/obese groups. Nutrition knowledge was moderate (8.2 out of 10 points) and no statistically significant knowledge differences were seen between groups. The authors pointed out certain discrepancies in knowledge as only 50% of participants correctly indicated what it meant to eat a balanced diet or were able to identify what “no added sugar” means when listed on a juice label. Regarding eating behaviors, 87% of respondents reported eating a variety of foods, and contrary to the authors’ initial thoughts, a greater percentage of overweight/obese vs. normal-weight participants reported eating a variety of foods (37% vs. 35%) or not having an unhealthy diet (64% vs. 55%). Physical activity (frequency and duration) was significantly different and in favor of normal weight vs. overweight/obese boys and girls ($P<.01$ and $P<.001$, respectively). Total self-efficacy (eating and physical activity) was moderate (31.9 out of possible 40 points) and both total and physical activity self-efficacy were significantly lower ($P<.01$ and $P<.001$, respectively) for overweight vs. normal

boys. Physical activity self-efficacy was also significantly lower ($P < .01$) for overweight vs. normal girls.⁷⁴ Unlike the previous studies mentioned, this study did not assess correlations between nutrition knowledge and behaviors, so no associations between these variables can be drawn. However, similarly to each of the previous studies, the potential for social desirability bias exists. The authors failed to address the difference that may be inherent in the responses of those who are overweight/obese vs. those who are not, particularly for nutrition-related information. Previous research has indicated that females have a greater degree of socially desirability bias than males^{75,76} and research has also shown that a higher BMI is associated with underreporting of energy intake.^{77,78}

The relationship between knowledge, attitudes, and behaviors is complex and not easily explained. Current research with adolescents suggests that knowledge and positive attitudes do not always translate to behavior change and further supports the notation of a disconnect between factual and procedural knowledge and self-efficacy. The previous studies were all cross-sectional and observational and can therefore provide only a broad snap shot of what is happening regarding nutrition knowledge and behaviors and health-related outcomes including overweight/obesity. To see if there is a relationship between these variables it is important to look to behavioral interventions.

2.1.4 Dietary Studies – Interventions

A cluster randomized intervention by Amaro et al⁷⁹ examined the potential of a food-related board game to provide nutrition knowledge and increase healthy dietary behaviors of 241, female (n=108), adolescents, 11-14 years old. Participants in the intervention group played a board game, designed to provide nutrition knowledge based on the Mediterranean diet, for 15-30 minutes each week for 24 weeks. The control group

did not play the game. Both groups completed pre- and post-intervention questionnaires to assess knowledge and dietary behaviors. Findings showed a significant ($P < .05$) pre-post intervention difference between groups for nutrition knowledge and a significant ($P < .01$) between groups difference for vegetable intake; however, an association was not found for nutrition knowledge and vegetable intake. Significant findings were not identified for physical activity or weight. The board game included only a limited number of cards (80 nutrition- and 20 physical activity-related).⁷⁹ Since the same game was played over a period of 24 weeks, the increases in nutrition knowledge may simply have been memorization of the repeated information from the cards. Additional limitations of this study include a homogeneous population (all Caucasian), and assessment method (non-validated food frequency and physical activity questionnaire). The study was also short-term, and exposure to the intervention was for very short periods of time (15-30 minutes).

In another school based intervention, Singh et al⁸⁰ examined the effectiveness of a dietary and physical activity behavior intervention for 1108 adolescents, 50% female, mean age 12.7 years-old. Participating schools were randomized to intervention or control groups. The intervention included 11 lessons delivered in the class by teachers and focused on behavior changes related to energy intake and output. Environmental elements such as advising schools on changes to cafeteria selections, encouraging additional physical education classes and offering more opportunities for physical activity (biking to school) were made to intervention schools. Control schools followed regular practices. Participants were assessed at baseline, 8-months, 12-months, and 20-months for anthropometrics (skinfold assessments, waist circumference, and BMI). Also, screen

time, activity, consumption of sugar-sweetened beverages, and snacks (sweet and savory) were assessed. Findings indicated that after the 20-month follow-up girls and boys in the intervention group reported smaller increases in skinfold measurements (-2.0 mm; 95% CI, -3.9 to -0.1 and -1.1; 95% CI, -4.4 to 0.2, respectively) than control groups. No significant differences in BMI were found for girls or boys in the intervention or control groups. Both boys and girls in the intervention group reported significantly lower consumption of sugar-sweetened beverages (approximately 250 ml/d difference) at 8-months and 12-months, but no significant between-group differences were found at 20-months.⁸⁰ Teachers reported that the program delivery was complicated and took more time than anticipated. While it is hard to interpret the impact of the teachers' feeling regarding the program, it is possible that it had a bearing on how the information was conveyed to students and as such is a study limitation. Also, selection bias is a concern as schools self-selected to participate. Although there were some positive changes in skinfold measurements and a reduction in sugar-sweetened beverage consumption the program components lasted only 11 sessions, which may not be long enough, and changes in the school environment may not have been significant enough or consistent across intervention schools to precipitate a behavior change.

In yet another program delivered in the school environment, researchers examined short-term (15 days) and long-term (12-month) effects of a nutrition intervention.⁸¹ Adolescents (12-13 years-old, 49% female), were randomized to an intervention group (n=98) or a control group (n=93). Teachers were trained in the program content and delivered the program over a 12-week period. Anthropometrics (height and weight) and dietary assessments (food frequency questionnaire) were collected at baseline, 15 days

and 12-months after the conclusion of the program. Short-term findings indicated significant, ($P < .001$) reductions in energy intake, total and saturated fat intake, and increases in protein intake for intervention participants. At 12-months, total and saturated fat reductions and increases in protein remained significant ($P < .001$). Analysis of individual food categories indicated significant reductions in red meat ($P = .028$), and increases in consumption of poultry ($P = .041$), ready-to-eat cereals, and fruits ($P = .036$) at 15 days. These results remained for red meat ($P = .021$), poultry ($P = .034$), ready-to-eat cereal ($P = .001$) and fruit ($P = .048$) at 12-months. No short-term differences were found for BMI; however, significant ($P < .001$) decreases in BMI were found for the intervention group at 12-months.⁸¹ While within group differences were analyzed, the authors did not examine between-group differences, which may have represented a clearer picture of the effect of the intervention. Limitations of the study included small sample size and short duration of exposure to the program elements (12-weeks). Although this study was longer than many and researchers stated the study was long-term, by definition long-term is considered greater than 12-months.⁸²

In a two-year study by Gortmaker et al⁸³ 1,295 6th-and 7th-graders (mean age 11.7, 48% female, 67% white) in Massachusetts were randomized by the school to an intervention or control group. The Planet Health obesity prevention program focused on behavioral changes including increasing fruit and vegetable and decreasing high-fat food consumption, reducing television viewing, and increasing physical activity. The program used Social Cognitive Theory⁸⁴ to inform development and focused on social and environmental elements that influence behaviors. The intervention included training for teachers, classroom curriculum, and physical activity materials. The prevalence of

obesity in girls decreased significantly ($P=.03$) in the intervention school and increased 2.2% in the control school at follow-up. Larger effects were seen in African American girls ($P=.007$) although the sample size was small in intervention ($n=9$) and control ($n=15$) groups. The prevalence of obesity in boys decreased in both control and intervention groups 2.3% and 1.5%, respectively. Regarding behavioral changes, girls in the intervention showed positive changes in fruit and vegetable consumption ($P<.003$) and total energy intake ($P<.05$). No significant behavioral changes were noted for boys.⁸³ Although knowledge does not necessarily indicate behavior change, nutrition knowledge was not assessed at all in this study, which makes it difficult to determine if the cause of the dietary behavior changes for girls was related to the program or due to other factors. Also, the differences in behavioral changes between girls and boys warrant additional analysis. As in the previous cross-sectional studies, this study used self-report of dietary consumption. Other limitations of this study include cluster randomization of schools and not randomization of individuals, and lower enrollment of ethnically diverse populations (numbers for some groups were so small that analyses could not be performed). While this study was 21-months, intervention programming occurred only during the school year and therefore exposure was not consistently maintained.

In a 4-year, physical activity randomized control study ($N=954$) 6th graders (12-years-old, 50% female) were cluster-randomized by schools to intervention and control groups.⁸⁵ The program included education for physical activity and sedentary behaviors as well as opportunities to engage in physical activity at school during lunch and break times. As part of the program, before and after school activities were also arranged for participating students. Intervention participants had a smaller increase in BMI ($P=.01$)

than the control group. Seventy-nine percent of intervention participant showed positive physical activity behaviors (defined as at least one additional physical activity per week) at 4 years, compared to only 47% of control participants. Supervised physical activity increased from baseline to 4 years in the intervention group and decreased in the control group ($P < .0001$).⁸⁵ This was a long-term study, and it did show positive results as an obesity prevention program, but the results are not as strong as a weight-loss program since those who were overweight at baseline were still overweight at the four years. Because the intervention had several different components, it is difficult to determine which elements had the greatest impact on the findings. In addition, although physical activity is important in weight loss and maintenance, dietary factors are also important. Although the authors mention that “a few dietary questions” were asked on the questionnaire, no results from those findings were presented.

Each of the interventions discussed above included different program elements and examined different outcomes. Several did not track nutrition knowledge or dietary behaviors such as fruit and vegetable consumption, or include a health-related outcome (e.g., overweight/obesity), which makes it difficult to compare results across studies. A 2006 meta-analysis of obesity prevention programs for children and adolescents provides an excellent synthesis of 64 prevention programs from 1980 – 2005.⁸⁶ One of the most significant findings was that 79% of programs evaluated did not produce statistically significant weight loss effects. In fact, the average effect size ($r = .04$) was negligible and provides further evidence that interventions have had only limited success in changing weight loss behaviors. Findings from these studies indicate that programs for adolescents

had greater effects than those for children, which suggests that delivering obesity prevention programs at this stage in the lifecycle may be especially beneficial.⁸⁶

2.1.4.1 Summary

Dietary cross-sectional and intervention studies that have examined the associations between knowledge, attitudes and dietary practices in adolescents, are limited by numerous factors. These limitations include small sample sizes, study design, varying program duration and lack of long-term (>12 months) follow-up. Furthermore, cross-sectional studies, while helpful in determining associations between variables, cannot show causation and findings from these studies must be viewed cautiously. Focusing on the elements that make programs successful is important in finding solutions for improving dietary behaviors; however, this is challenging to do as programs include a broad range of components. The variation in age groups across studies is also problematic and makes it difficult to compare results as nutrition needs and cognitive development vary between age groups.⁸⁻¹⁰ Also, although self-report is a standard method of collecting information on dietary behaviors it is subject to reporter bias. While it is well known that knowledge alone does not guarantee positive changes in dietary practices, knowledge is still an important part of the process that must be operationalized to achieve desired behaviors.

Adolescent overweight/obesity is a public health concern and additional research into behavioral or lifestyle change programs is important for the prevention and treatment of obesity.^{82,87,88} However, adolescents pose a unique challenge when developing effective programs because they process information differently from other lifecycle stages.^{8,10} To move this complex field of research forward, it will be important to

examine how adolescents understand and interact with food at a foundational level. In doing this, novel forms of programming will be developed.

2.2 The Literacies of Health, Nutrition, and Food

2.2.1 Literacy Background

Reading, writing, basic mathematics, speech, and speech comprehension define the foundational skills of literacy.⁸⁹ These skills vary throughout life and are thought to change depending on an individual's situational context.^{89,90} For example, despite having a college degree, a 45-year-old person may experience a deterioration of vision which affects his or her ability to read. Literacy skills are essential for carrying out activities of daily living, particularly those related to health, nutrition, and food. For instance, a simple task such as scheduling and keeping a doctor's appointment is largely based on an individual's ability to comprehend speech, read, write, and even calculate basic math (e.g., time to leave for the appointment). Capacity to use a nutrition label or prepare a recipe requires both reading and math skills. Literacy helps individuals navigate through important tasks related to health and well-being.^{90,91}

The National Adult Literacy Survey (NALS) is a task-oriented literacy assessment focused on activities of everyday life.⁹² In 2003, over 19,000 participants took part in the NALS.⁹² Participants were provided with text and asked to accomplish specific tasks. Several of the tasks included skills such as locating information in text (e.g., age of a person), comparing or contrasting information (e.g., different views on a topic). In other instances participants were asked to extract information from complex text and tables (e.g., locate a series of numbers in a table and develop a graph to display).^{92,93} Scores were based on the ability to accomplish the requested tasks. Findings indicate that

approximately 30 million Americans had below basic prose literacy (e.g., ability to read, understand and use information in written material such as news stories, brochures, and instructional resources).⁹² Twenty-seven million people have below basic document (e.g., ability to read, use, and understand, non-continuous written material such as food labels, application forms, or bus schedules).⁹² While 46 million have below basic quantitative literacy (e.g., understand and perform calculations related to numbers appearing in written information such as bank statements or order forms).⁹² Older adults (≥ 65 years old) had the lowest average literacy score among all age groups for prose (23% below basic), document (27% below basic) and quantitative (34% below basic).^{92,94} Among 16-18 year-olds, only 11% had below basic skills for prose and document literacy and 28% had below basic quantitative skills.⁹² While a higher percentage of adolescents had basic literacy skills, fewer were proficient in these same skills.⁹² This is concerning because the average person reads at an eighth-grade (~13-14 years-old) level and 20% read at a fifth-grade (~10-11 years-old) level or below.^{93,95} Despite this, much of our health information is written above an eighth grade reading level.^{95,96} Recognizing the importance of the link between literacy and health is the foundation upon which the field of health literacy has emerged.

2.2.2 Health Literacy Background

Health literacy is a cognitive skill grounded in the functional elements of literacy; namely, print and oral literacy, as well as numeracy and conceptual knowledge.⁹⁰ In addition to these fundamental or functional elements, are the concepts of interactive literacy and critical literacy.^{5,6} Interactive literacy skills involve the ability to obtain, process, and apply information in cultural, technological or scientific situations.^{5,6}

Critical literacy requires the ability to analyze and apply essential information to navigate the larger societal environment (healthcare systems, built environments, policies, etc.).^{5,6} These higher order health literacy components necessitate the processing and application of health concepts at the individual and societal levels.^{5,6}

Health literacy has the potential to affect large segments of the population. In 2003, the NALS included a section on health literacy about health-related behaviors and actions.⁹⁴ Results from this survey indicated that nearly 9 in 10 Americans, were not proficient in health literacy and had difficulty navigating the healthcare system.⁹⁴ The youngest participants (16-18 years-old), were less likely to be proficient in health literacy (8%) compared to all other age groups, excluding those 65 and older (3%).⁹⁴

There are many definitions of health literacy.⁹⁷ These definitions often vary based on the context in which the concept is used, (i.e., whether health literacy is viewed as an individual issue or a public health concern).⁵ The most widely used and accepted definition was provided by the Institute of Medicine in their comprehensive review of the subject in 2004.⁹⁰ “*Health literacy is the degree to which individuals can obtain, process, and understand the basic health information and services they need to make appropriate health decisions.*”⁹⁰ This definition addresses the individual, but also how the individual works within a larger environment or system. In 2010, the Affordable Care Act added the term “communicate” to highlight the need for patients to communicate health care needs and concerns.⁹⁸

Health literacy is a significant public health concern. It can predict an individual’s health status more strongly than any other factor, including socio-economic or employment status, educational attainment or even racial or ethnic group.⁹⁹ Low health

literacy can negatively impact an individual's ability to navigate the healthcare system.^{90,100,101} Also, it can affect a person's capacity to manage chronic diseases, follow a healthy diet, monitor medication, and read educational materials.^{90,100,101} Individuals with low literary skills are also more likely to be admitted to the hospital and be readmitted after initial discharge.^{90,91,102-104} Overall, health literacy affects morbidity and mortality and puts individuals and the entire health care system at risk.^{90,100,101} Estimates are that the additional costs of low health literacy on an individual level are between \$143 and \$7,798 per person per year.¹⁰⁵ On a public health level, these increased costs may range from 3 to 5% of total healthcare costs.¹⁰⁵

Educational attainment and reading level are often used as a proxy for health literacy level. However, low health literacy can affect individuals of all economic, educational and health levels.^{106,107} For instance, if a highly educated person has just been diagnosed with cancer the diagnosis may be so startling that it is difficult for the individual to comprehend what needs to be done for his/her health care. On the other hand, a single mother who has a high school education and is caring for a child with diabetes is very likely to have a high level of health literacy in relation to her child's health care, despite relatively few years of formal education. The literature on health literacy is filled with stories on the impact of health literacy and context-specific situations.^{90,104}

There are many ways in which health literacy is measured and the Health Literacy Tool Shed database includes 128 different measures.¹⁰⁸ Three tools which have been widely used to help establish the relationship between health literacy and health outcomes are the Rapid Estimate of Adult Health Literacy in Medicine (REALM), The Test of

Function Health Literacy in Adults (TOFHLA) and the Newest Vital Signs (NVS).¹⁰⁹⁻¹¹¹ These are just three of the many tools cited in the literature and touted as health literacy measures; however, the question remains as to what aspect of health literacy they truly measure. None of these instruments provides participants with the opportunity to process and apply information within a healthcare context; yet, these are two critical components of the health literacy definition.

Health literacy is a complex and dynamic concept that blends health knowledge and health action to help empower people to achieve better health outcomes. Despite an increase in interest in health literacy, the concept is not often discussed in the field of nutrition.⁹⁵ Health literacy is an essential element in many nutrition-related management skills, such as self-monitoring (e.g. weight and blood glucose), analyzing food labels for carbohydrate content or laboratory values for lipid levels, and navigating the complex and extensive healthcare environment to access proper care for diet-related conditions.¹¹²⁻

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2.2.3 Nutrition Literacy Background

Nutrition literacy is a subset of health literacy because at its core nutrition is tied to disease prevention and ultimately overall health.^{7,115} There is no standardized meaning or definition of “nutrition literacy;” however, Silk and colleagues developed the following working definition: *“The degree to which individuals can obtain, process, and understand the basic nutrition information and services they need to make appropriate nutrition-related decisions.”*¹¹⁶

Like health literacy, nutrition literacy can be thought of in terms of three domains: functional, interactive, and critical.¹¹⁷ For someone with diabetes, functional nutrition

literacy can include the ability to read a nutrition label to determine the number of carbohydrates. At the interactive level, this individual would be able to analyze the carbohydrate information from the label and apply it to his/her daily food selections. From a critical domain level, this individual may use nutrition label information to understand how government policy and regulation impacts not only his/herself but the role the policy plays on a larger scale in helping or hindering others with diabetes.

Few efforts have been made to assess or measure nutrition literacy. Several nutrition literacy tools such as the Nutrition Literacy Scale¹¹⁸ and The Nutrition Literacy Assessment Instrument¹¹⁹ have begun to emerge from the literature. Even with these new measures, health literacy tools such as the Newest Vital Sign and the Nutrition Label Survey are often used as a proxy for Nutrition Literacy. However, these health literacy tools have not been validated to measure the unique nature and attributes of nutrition literacy.⁹⁵

2.2.4 Health Literacy and Nutrition Literacy Studies

Diabetes self-management skills rely heavily on literacy-, health literacy-, and nutrition literacy-related competencies, including reading and numeracy. Research in this area has shown some association between literacy, numeracy and health outcomes. For instance, in a cross-sectional study by Williams et al¹¹³ of individuals with hypertension and type II diabetes, participants with diabetes (n=114) who had inadequate health literacy (assessed with TOFHLA) had less knowledge of the symptoms of hypoglycemia than those with adequate health literacy ($P < .001$).¹¹³ Although the study showed a trend toward poorer health outcomes (i.e., higher blood glucose and A1C levels) among participants with lower health literacy, there was no significant relationship.¹¹³

In another cross-sectional study, Schillinger et al¹²⁰ found that participants (N=408), with type II diabetes, were twice as likely to have poorer control of their condition (A1C \geq 9.5%; adjusted OR, 2.03; 95% CI, 1.11-3.73; $P=.02$) than those with higher health literacy (measured with s-TOFHLA). The study further reported a statistically significant relationship between health literacy level and diabetes-related outcomes, such as retinopathy even after adjustment for self-report vs. billed status (adjusted OR, 2.33; 95% CI, 1.19-4.57; $P=.01$).¹²⁰ Williams et al¹¹³ did find an association with the length of time an individual had diabetes and their diabetes knowledge. Schillinger et al¹²⁰ did not address length of time with the condition and it is possible the longer a person has the condition, the greater their exposure to the medical terms such as those listed on the TOFHLA form.

Both of the previous studies were cross-sectional in design and can only indicate the association between health literacy and diabetes-related outcomes. A 2016 intervention that sought to improve medication adherence for patients with diabetes provides evidence of the effect of a video program.¹²¹ Participants with lower literacy levels (measured by REALM) showed significantly greater improvements in self-efficacy ($P=.02$) after watching a series of diabetes-related videos. Also, fewer participants with lower literacy reported problems in taking prescribed medicines (mean 6.14 at baseline and 5.03 at follow-up).¹²¹ Limitations of this study included small sample size (N=51) and low exposure to videos (mean number of videos watched were 3.7 out of 8 videos), and self-reported responses including health status. In addition, 80% of the participants were female and black or African American, which makes it difficult to generalize the results to other populations.

Much like the rising rates of diabetes, there has been an overall increase in the prevalence of overweight/obesity¹²²; yet, the relationship between health or nutrition literacy and weight (overweight/obesity) has not been well studied. Components of health literacy related to nutrition skills; namely, numeracy, have been touched on in the literature. For instance, in a 2008 study by Huizinga et al¹²³ 160 participants with a mean BMI >30 were significantly more likely to have low numeracy (<9th grade level), than those with a BMI <30 ($P=.033$). In addition, when numeracy was treated as a categorical variable, participants with low numeracy (<9th-grade level) had a higher mean BMI than those with a higher numeracy level (>9th-grade), 27.9 (SD 6.0) and 31.8 (SD 9.0), respectively.¹²³ These low numeracy skills were in contrast to relatively high reading and pronunciation skills (mean of 61 out of 66 points on REALM) thus suggesting that a particular component of literacy (i.e., numeracy) needs to be addressed. While this is a possible conclusion based on the results, the study did not test a real world understanding or use of numeracy (e.g., reading of nutrition label, label values, or recipe adjustment). Health literacy and the proxy numeracy need to be assessed in relationship to actual dietary behaviors in order to gain a true understanding of the impact of these variables on overweight/obesity.

Kennen et al¹²⁴ examined the relationship between prose literacy and weight-related knowledge and readiness to lose weight among obese patients (N=210). Although this study did not look at health literacy *per se*, it incorporated health literacy-related components such as accessing overall health and taking appropriate action to improve health. When participants were asked to complete a REALM assessment, many could not read the following words on the form: *obesity* (43%), *diabetes* (39%), *nutrition* (28%),

calories (22%) and *exercise* (17%). When participants were asked if weight affects health, only 50% of those with lower literacy, ($\leq 6^{\text{th}}$ -grade level) said *yes*, as compared to 72.5% of people with higher literacy, ($\geq 9^{\text{th}}$ -grade level). In addition, a smaller percentage of participants with lower literacy believed they needed to lose weight (84.9%) or wanted to lose weight (80.3%) than those with higher literacy (97.1% and 94.2%, respectively).¹²⁴ Future studies should look to include a sample of participants who are not overweight/obese so a comparison can be made across all weight categories. What is revealed could provide clues to the differences between groups. While the study design, cross-sectional, does not show a true relationship between low literacy and overweight/obesity there are perhaps connections to an understanding of what impact low health literacy has on understanding or managing overweight/obesity.

While the findings across the previous two studies are mixed, there is some evidence of a relationship between lower health literacy and weight management skills. Weight loss and maintenance is a complex task that requires an understanding of what constitutes a healthy diet. The Dietary Guidelines for Americans include recommendations for the general population, which is intended to provide guidance on healthy eating.¹²⁵ A 2011 cross-sectional study (N=376) by Zoellner et al¹¹¹ examined the association between Healthy Eating Index (HEI) Scores and health literacy levels in a population from the rural lower Mississippi Delta. The HEI is based on the Dietary Guidelines for Americans and is a measure of how well a diet adheres to the overall recommendations.¹²⁶ Higher HEI scores represent greater adherence to the Dietary Guidelines. Participants in this study were primarily African American (67.6%), did not have a college degree (71.5%), and came from households with an income level

<\$20,000/year (55.0%). When adjusted for demographic variables, results from this study indicated for each 1-point increase in health literacy there was a 1.21-point increase in Healthy Eating Index scores ($P<.01$). Health literacy was also positively associated with subcomponent HEI scores for whole fruit ($P<.03$), total vegetables ($P<.01$), dark green and orange vegetables and legumes ($P<.01$), oils ($P<.01$), and solid fat, alcohol, and added sugar ($P<.01$). Participants with a high likelihood of limited health literacy consumed more calories (119 kcal/per day) from sugar-sweetened beverages than participants with adequate health literacy.¹¹¹ Though it is not possible to truly generalize these results to other populations the implication is that higher literacy levels may be related to better-eating practices.

Portion size estimation and label reading are essential components in understanding and maintaining healthy eating practices. Several studies have assessed these issues in relationship to literacy. In 2009 Huizinga et al¹²⁷ examined the association between literacy, numeracy, and skills needed in portion-size estimation. Participants (N=164) were administered the REALM and the Wide Range Achievement Test – 3rd Ed., (WRAT-3). Findings from the study indicated that lower literacy and numeracy skills were associated with overestimation of portion size. Fifty-five percent of people with lower literacy and 95% with lower numeracy overestimated portion size compared to participants with higher literacy (17%) and numeracy (65%).¹²⁷ Estimating portion size and reading labels are complex tasks and use many different types of literacy-related skills such as reading and numeracy. Portion estimation is a necessary, albeit, overlooked, skill required in the management of weight loss and diabetes, and is a major component of processing and understanding nutrition labels. Additional research is needed to

understand how people navigate the process of portion estimation, how they comprehend the difference between portion size and serving size, and how this impacts their use of nutrition labels.

Serving sizes represented on the nutrition label often vary from the actual portion size of the product. For example, a 20-oz soda bottle is considered 2.5 servings. In a study that examined the relationship between literacy and numeracy and patients' understanding of nutrition labels, 200 participants were administered a series of literacy and numeracy tests including the REALM, WRAT-3, and the Nutrition Label Survey (NLS).¹²⁸ The NLS was developed to assess an understanding of nutrition label information and has not been validated. There was a statistically significant association between literacy level and performance on the NLS. Participants with higher literacy and numeracy skills performed better on the survey than participants with lower literacy and numeracy skills ($P < .0001$ for both). In addition, 68% of participants could not calculate the amount of carbohydrate in a 20-oz bottle of soda.¹²⁸ Limitations of this study included its cross-sectional design and lack of validation of the NLS. It is not possible to draw a conclusion that performance on the NLS will equate to actual dietary practices. To determine this, a participant's actual dietary practices must be assessed.

2.2.4.1 Summary

A limitation of the studies described above is their cross-sectional design. Cross-sectional studies often help address the initial questions needed in the research process and can contribute to identifying gaps and the direction for future studies.¹²⁹ However, without the inclusion of a control group, or the use of an intervention to analyze the effect of change, no direct causal link can be drawn between health or nutrition literacy and any

component of a disease outcome. Future studies that include control groups, track health and nutrition literacy changes over time, and assess actual dietary changes in relationship to health and nutrition literacy level, may provide a better understanding of the connection between health and nutrition literacy and nutrition-related outcomes.

It is estimated that 90% of the U.S. population does not have the necessary skills and ability to navigate the complexity of the healthcare system, and adolescents and older adults may be the least prepared to do so.⁹⁴ The increasing prevalence of overweight/obesity and comorbidities such as type II diabetes, cardiovascular disease, and hypertension make it imperative to understand potential links between health and nutrition literacy and these conditions. Moving forward it will be important to understand the complex relationship between health and nutrition literacy, and dietary behaviors. By definition health and nutrition literacy are about more than just understanding a concept, they are about *interpreting* how to use knowledge and applying the knowledge to improve health and well-being.⁹⁰ Regarding, nutrition literacy this extends to understanding how to use food-related knowledge.

2.2.5 Food Literacy Background

The rise in overweight/obesity has led researchers to investigate potential mechanisms for developing healthy dietary eating habits. The term FL is a relatively new concept used to describe the relationship between food knowledge, skills, and behaviors.^{7,130-133} It is rooted in the idea that we eat food, not nutrients and yet people are often asked to conceptualize or interact with food on a nutrient level.¹³⁴ Therein is the disconnect and highlights the need to examine the role FL plays in helping people understand, interact, and engage with food in a healthy way.

There is no consensus about the meaning of FL; the term is often operationalized in different ways, depending on the context or framing of its use.^{7,130,133,135} An early definition closely resembled the definition for health literacy.¹³⁶ Vidgen and Gallegos¹³³ expanded on earlier definitions of FL to include “*the scaffolding that empowers individuals, households, communities or nations to protect diet quality through change and strengthen dietary resilience over time. It is composed of a collection of inter-related knowledge, skills, and behaviors required to plan, manage, select, prepare and eat food to meet needs and determine intake.*”¹³³ This definition recognizes the collaborative nature of food-related knowledge and behaviors and identifies the FL specific domains of planning and managing, selecting, preparing and eating food.

The role of FL within the constructs of health and subsequent nutrition literacy is not clear. In 2011 Vidgen and colleagues¹³¹ conducted a qualitative study with food experts (food industry professionals, chefs, and nutrition professionals) in an attempt to discern the relationship between FL and nutrition. Some food experts believed that FL was indirectly related to nutrition and mediated by social determinants as well as individual food preferences.^{7,131} Others felt that nutrition knowledge was a subset of FL. While still, others believed the concepts mutually exclusive comprising different dimensions of knowledge, attitudes, and skills.^{7,131} In a viewpoint by Velardo,¹³⁰ FL was positioned as a component of nutrition literacy linked through the relationship between dietary knowledge and practical food skills. This theory is supported by Pendergast et al¹³⁷ who also referenced the term as a subset of health literacy. In 2012 Vidgen and colleagues¹³² conducted a second study this time with adolescents. Here the relationship between FL and nutrition reformed as an input and outcome.¹³² FL with its four domains

(planning and management, selection, preparation, and eating) were the inputs needed to affect the outcome of nutrition (i.e., dietary knowledge, attitudes, behaviors). However, describing the impact of FL on nutrition outcome does not explain the specific relationship between FL and nutrition literacy *per se*. The definitions of nutrition “*the act or process of nourishing or being nourished*”¹³⁸ and nutrition literacy “*The degree to which individuals can obtain, process, and understand the basic nutrition information and services they need to make appropriate nutrition-related decisions*”¹¹⁶ are different. The former is describing food in terms of nourishment or sustenance while the latter is explaining a process related to better nutrition-related outcomes. FL is in its infancy and more work needs to be done to determine the relationship if any between the formal literacies of food, nutrition, and health. However, one connection between these literacies may be through an analysis of functional, interactive, and critical components a common theme amongst all three literacies.

Similarly to health and nutrition literacy, FL can also be viewed as having three levels: conceptual knowledge, procedural knowledge, and motivation to participate.¹³⁴ These align with functional, interactive, and critical health/nutrition literacy.¹³⁷ Conceptual knowledge is factual knowledge related to food.¹³⁴ Procedural knowledge is the knowledge of what to do with food.¹³⁴ Motivation to participate is the application of information that moves individuals’ prior knowledge into action.¹³⁴ Someone may have basic knowledge about food and how to properly prepare it but, if he/she is not motivated or interested in applying this knowledge, the action will not occur. For example, a person may understand the importance of eating a variety of vegetables (conceptual knowledge) and he/she may know how to cook vegetables (procedural knowledge). However, if

he/she does not like to cook, then despite having the knowledge, it will not translate into eating more vegetables. Knowledge is important, but alone it is not enough to initiate behavior change.^{134,139}

2.2.6 Food Literacy Studies

FL programs are based on the assumption that there is a relationship between food-related knowledge and skills, and food-related behaviors. Recent studies have examined specific elements of FL and their impact on knowledge, attitudes and dietary behaviors. For example, in a qualitative study by Fulkerson et al¹⁴⁰ a convenience sample of 27 parents/guardians, 84% female, age range 23 to 65 years-old, reported a frustration with their children's eating habits, particularly food preferences (e.g., eating a limited number of foods). Also, parents indicated that although children wanted to be involved in meal preparation, they were not often encouraged to help because of time constraints during meal times. Eating a smaller variety of foods reduces the likelihood of meeting dietary recommendations, and previous research has linked the frequency of meal preparation and healthier dietary practices in adolescents.¹⁴¹ Some research has also found that cooking programs that focus on practical applications, as well as tasting opportunities, may help encourage healthy eating behaviors.^{142,143} FL programs that offer greater exposure to foods through taste testing and encourage children to help prepare foods for cooking lessons or offer interaction with recipes are needed.

Cook It Up! is a community-based cooking program for at-risk-youth in Ontario, Canada.¹⁴⁴ A 2011 article presents a review of the design and implementation of the program. The aim of the program was to increase cooking skills as well as food purchasing and preparation skills, knowledge of agriculture practices, and healthy eating

awareness. A steering committee was formed including community stakeholders such as chefs, local farmers, education specialists, and a social service agent, but did not include a youth spokesperson. The program was introduced to the community via media sources (television, newspapers, social media) as well as through connections with local agencies. Participants were required to apply and interview for the program. Five girls and three boys, mean age 14.6 years old, participated in the 18-month program, which included bi-monthly cooking sessions as well as field trips to local farms and farmers' markets.¹⁴⁴ Pre/post cooking skills were assessed by questionnaire. Participants also completed a final Photovoice project focused on their perceptions of barriers and benefits to the development of cooking skills. The article focused on the implementation of the program and did not provide results from the pre/post questionnaire. While there is no way to know if the program impacted healthy behaviors, it does provide an outline of a program that addresses multiple components of FL including planning and managing, selecting, serving, and eating foods. It is a range of FL skills that are needed (e.g., planning and managing and preparing) to affect behavior change.

The previous two studies offer an insight into important qualities in designing FL programs; however, the question remains whether or not FL programs work in increasing adolescent's food knowledge, attitudes, and changing eating behaviors. In a 2015 study that evaluated an after-school cooking program for low-income children, 51 5-12 year-olds reported increasing the amount of fruit consumed per day by one piece at the end of the five session program.¹⁴⁵ Significant increases also occurred in knowledge ($P=.02$) and self-efficacy for eating fruits ($P<.001$) and vegetables ($P=.009$) and nonsignificant decreases were reported for glasses of sweetened drinks consumed. Each session took

place after school, lasted 90 minutes, included a healthy snack, and focused on preparing a recipe. Parents of the children were encouraged to attend a separate activity session, which included information about the benefits of eating healthy foods and forming healthy habits. Parents also sat with the children and tasted the food prepared by their child. At the end of the session, families received a “vegetable of the week” along with a recipe using the item.¹⁴⁵ Although there were modest increases in healthy dietary practices after this short-term study, the study was small and lacked a control group. Moreover, not all participants completed the surveys, which further reduce the sample size (n=38), and surveys relied on self-report. Multicomponent programs make it difficult to determine which element (i.e., session for children or parent involvement) impacted the results. Despite these limitations, it may be important to promote increased cooking skills as there may be an association between involvement in preparing meals at home and better dietary habits.¹⁴⁶⁻¹⁴⁸

In another study that investigated the effects of a cooking program, Condrasky et al¹⁴⁹ examined the changes in nutrition knowledge, cooking and skills and self-efficacy of participants in a culinary camp. Ninety-nine adolescents, 64.7% female, between the ages of 10 and 14-years attended the camp for between 1 and 3 weeks from 9:00 am to 4:00 pm Monday through Friday. The focus of the camp was on basic cooking skills and techniques and participants prepared a variety of foods over the course of the weeks. Pre- and post-program questionnaires were administered to assess changes in nutrition knowledge and cooking skills as well as changes in confidence to engage in healthy dietary behaviors. Participants ranged in age from 10-14-years old, and 64.7% were female. Nutrition knowledge increased ($P=.001$) as did confidence in eating fruit, making

a fruit or vegetable snack, trying a new recipe and helping to cook healthy dinners ($P < .0001$).¹⁴⁹ Although no information was provided on session attendance, the authors indicated that participants had the option to attend the camp for 1, 2, or 3 weeks. While the program was designed to provide medium to intensive (30-90 hours) exposure to culinary experiences, the results are limited by participant's actual exposure to the intervention. In addition, the intervention did not include a control group, so it is hard to determine if the program components were responsible for the changes in knowledge and self-efficacy.

Evans et al¹⁵⁰ did include a control group in a school-based intervention. Five middle schools representing ethnically diverse, low-income communities participated in the study and were assigned to an intervention ($n=4$) or control group.¹⁵⁰ More than half of the 246 participants (59%) were Hispanic, and 70% were low-income. Researchers compared participants' post-intervention nutrition knowledge, attitudes, and motivation to make dietary behavior changes based on exposure to intervention components (classroom lessons, after school garden activities, field trips to farms, school cafeteria changes, food tastings, and farmers visits). Those who were exposed to two or more components had significantly higher nutrition knowledge, self-efficacy, and self-reported consumption of fruits and vegetables ($P < .05$), and a lower preference for unhealthy foods ($P < .01$) than those exposed to less than two program components. The components that showed the most positive impact on fruit and vegetable consumption were farmers visits and food tastings although results were not significant.¹⁵⁰ Due to logistical issues at the beginning of the study, comparisons were not made for pre- and post-intervention assessments. Findings suggest higher nutrition knowledge, self-efficacy, and better

dietary behaviors for those who participated in at least two or more program components. However, pre-intervention assessment data is not available therefore it is not possible to ascertain if these participants had higher scores at baseline. This data could significantly alter the results. In addition, the intervention was not consistently administered across participating schools, which could have a bearing on the outcomes. Finally, although the intervention lasted 5-months, only four nutrition-based lessons were taught, on average three taste-tests occurred, one field trip to a farm was planned, and a farmer visited once or twice. The only component that happened consistently was the school garden activity, which included an after-school session once a week and this component had minimal impact on increasing the consumption of fruits and vegetables. Long-term studies that include consistent exposure to the intervention components are needed to examine the lasting effect on nutrition knowledge, attitudes and dietary behaviors.

Laska et al¹⁵¹ reviewed data collected from a 10-year longitudinal study of 1,321 young adults who participated in the *Eating Among Teens and Young Adults* (EAT) project. Initial enrollment (EAT-I) occurred when participants were adolescents (15-18 years-old). At enrollment food-frequency questionnaires and data regarding food preparation practices were collected. Data were again collected 5 years later (EAT-II) and, yet another assessment was made 10 years into the study (EAT-III). Adolescents who engaged in food preparation activities (EAT-I) were more likely to report purchasing fresh vegetables ($P<.001$) or preparing a full dinner ($P<.001$) 5 years later (EAT-II). Associations were also found between adolescent behaviors such as preparing dinner with an enjoyment of cooking 10-years later for males ($P=.003$) and females ($P<.001$), but few positive associations were found between adolescents' practices reported in

EAT-I and EAT-III. In fact, several negative associations were found. For example, adolescent males who helped prepare dinner reported eating fewer vegetables 10-years later and adolescent females who helped prepare dinner reported eating fewer grains in EAT-III. However, both males and females who had greater food preparation practices scores at EAT-II reported eating significantly more ($P<.01$) fruit, vegetables and dark green/orange vegetables, and less sugar-sweetened beverages when assessed 5 years later (EAT-III).¹⁵¹ A limitation of these results is the use of different assessment methods across all three time periods, which makes it difficult to compare differences. While this study was long-term, it was not an intervention and can only provide us with observational data. It is important to offer long-term follow-up on intervention studies to see if food and nutrition education can influence practices in adulthood.

2.2.6.1 Summary

Current dietary trends indicate that adolescents do not have healthy eating practices, but there is no clear path to solving this problem. FL has been proposed as a method to help understand the complex interaction of food knowledge, attitudes, and behaviors. The main constructs of this emerging literacy are: 1) planning and managing; 2) selecting; 3) preparing; and 4) eating, food.¹³³ Although FL may incorporate many different types of food related skills, cooking-related skills may be an important aspect of building overall FL skills.

Cooking is an art and science that requires an understanding of the way food comes together to achieve a final product. The process of cooking, and eating what is cooked, includes all four of the constructs of FL. Cooking is often included in FL programs^{139,152} and incorporating elements of cooking, such as recipe exploration and

taste tests, is a best practice to help build adolescents' capacity to make healthy decisions regarding foods.

While some studies have shown positive short-term results, these studies do have limitations. For example, limitations include small sample size, study design, and lack of consistent exposure to program elements. Studies often include a multitude of program components. This makes it difficult to determine the impact of a specific element in relationship to an observed change. Likewise, studies also include varying degrees of the key constructs of FL. These variations make it difficult to compare studies or even determine the most important or most effective FL domains. It should also be noted that only one of the studies reviewed for this section actually made mention of FL as a basis for program development.¹⁴⁴ The original authors of the remaining studies may not have intended the programs as FL studies and therefore the assessment of the programs through the lens of FL is a limitation. Because FL is an emerging concept and few true FL programs exist there remains a major gap in the literature surrounding this topic particularly regarding adolescents.

2.3 Technology and Adolescents

2.3.1 Background

Adolescents today have not known a time without technology. In fact, 92% access the Internet daily and one in four go online nearly all the time.¹² These “digital natives” have grown up in a world with email, cellphones, Internet, and social media. According to a 2015 report from Pew Internet and American Life Project, nearly 87% of adolescents aged 13-17 have access to a computer, 58% a tablet computer, and 88% have access to a

mobile phone. Overall mobile phone usage has risen 13% from 2013; within this group, smartphone usage has increased from 47% to 73%.¹²

Although the digital divide may still exist, several trends have begun to emerge. For instance, 78% of adolescents in higher income households (>\$75,000) have access to a smartphone, and 61% of those in lower income households (<\$30,000) also have access to smartphones.¹² In addition, 91% of lower income adolescents access the Internet via mobile devices compared to 92% in higher income adolescents. Among racial/ethnic groups, smartphone usage is greater in African-American adolescents (85%) than white (71%) or Hispanic youth (71%).¹²

Social media and text messaging have significantly influenced the landscape of how adolescents are using their cellphones. Seventy-six percent report using social media; of this group Facebook was the most popular site (76%).¹² Sending text messages is also a common form of communication for this group with 91% using their cellphones for text messaging, sending on average 67 text messages each day.¹²

Adolescent's use of technology has caught the attention of researchers. The appeal of technology to this age group may be a benefit to engaging adolescents to participate in technology-driven programs. Other advantages of technology vs. traditional face-to-face educational programs include the expanded reach to larger segments of the population and the ability to provide access to remote and rural communities not easily accessed by conventional methods. In addition, convenience in obtaining and disseminating information, cost-effectiveness (after initial startup), automated data collection, and the potential for tailoring information and feedback to individuals are advantages of the use of technology.¹⁵³ Previous clinical trials that have looked at the use

of the Internet for behavioral weight management programs have shown modest results in adults.¹⁵³⁻¹⁵⁸ In a study by Tate and colleagues,¹⁵⁵ 91 overweight adults, 18 to 60 years-old, 89% female, and 84% white, were randomly assigned to an Internet behavioral therapy group or an Internet-only education group. Of the 65 who completed the program those in the Internet behavioral group lost significantly ($P=.005$) more weight (4 kg) at 3 months than those assigned to an Internet-only education group (1.7 kg).¹⁵⁵ In another study by Tate et al¹⁵⁶ 92 participants at risk for type II diabetes, 90% female, mean age 48.5 years and BMI 33.1, were assigned to an Internet plus e-counseling group or an Internet-only group. At 12 months those in the e-counseling group lost significantly more ($P=.04$) weight (4.4 kg) than the Internet-only group (2.0 pounds).¹⁵⁶ In yet another study, 192 overweight adults, 94% female, mean age 49.2 years, mean baseline BMI 32.7, were randomly assigned to one of three groups: control group no counseling, automated computer feedback, or email counseling.¹⁵⁸ All groups received access to a website and one face-to-face session. At 3 months both automated and email counseling groups lost significantly more weight than the control group, 5.3 kg, 6.1kg, and 2.8 kg respectively; however, at 6 months only the email counseling group continued to lose weight.¹⁵⁸ Harvey-Berino et al¹⁵⁷ sought to examine the effectiveness of Internet support on long-term maintenance of weight loss. After completing a 6-month behavioral weight loss program, 255 participants, 82% female, baseline mean BMI 31.8, were assigned to one of three groups: frequent in-person support, minimal in-person support, and Internet support. At 12 months there were no significant weight loss differences between groups; however, the weight loss of those assigned to the Internet group was comparable to those assigned to in-person support.¹⁵⁷

It is hard to compare these studies because the educational and behavioral components, as well as the duration of exposures to each program, varied. Despite these limitations, the results suggest that the Internet is an effective method to deliver behavioral weight loss programs for adults. The link between technology and weight loss is much more prominent in the literature of adult populations. Research in this area for adolescents provides results that are not as clear in linking technology and weight loss.^{153,159-162}

2.3.2 Internet-Based Studies

Winett et al¹⁶³ used a quasi-experimental design to investigate changes in nutrition-related behaviors after using an Internet-based program. The program called *Eat4Life* focused on increasing consumption of fruits and vegetables, fiber, and regular meals and reducing consumption of soda, high-fat snacks, and dairy products in 9th and 10th-grade girls. Classes were assigned to the intervention or control group based on access to school computers. The intervention took place during health class. Comparisons were made between students who used Internet-based *Eat4Life* modules (n=103) and those who did not use the modules but received standard health education during class (n=77). At each computer session, participants completed an assessment of dietary practices. Tailored feedback was given to participants at each session based on their dietary practices. In addition, each computer session focused on one or two program objectives (e.g., increasing fruit and vegetables or reducing soda consumption). Those in the computer group reported statistically significant positive changes in the consumption of fruits and vegetables, fiber, and regular meals ($P<.001$) and decreased soda consumption ($P<.05$), compared to the control group. Positive increases were also seen in

physical activity ($P < .05$) among intervention participants.¹⁶³ Limitations of this study include lack of randomization (classrooms assigned to intervention based on the availability of computers), unequal group size, and use of self-report for behavior change. The intervention also included personalized feedback on progress. These factors make it difficult to determine if the differences in groups were due to the educational components alone. The length of the program was short (approximately 2 months implied but not formally indicated), and no post study assessment was conducted to see if results were maintained over time.

In another quasi-experimental study, Long and Stevens¹⁶⁴ assessed the impact of a web-/classroom-based nutrition education program on the self-efficacy for healthy eating among 121 adolescents, 12-16 years old, 51% female, and 40% Hispanic. Participants were not randomly assigned to groups; instead, they were assigned based on the ability to participate in the program. The month-long intervention included web-based (5 hours) and classroom-based (10 hours) nutrition education. The control group received the content of the classroom-based nutrition education embedded within another class (health, science and home economics). Participants in the intervention showed higher pre-/post-test differences in self-efficacy for healthy eating of fruits and vegetables and lower fat, usual food choice, dietary knowledge of fat, and consumption of fruits vegetable and fat; there was no reported change in eating behavior. Significant between group changes in self-efficacy for healthy eating for fruits and vegetables ($P < .05$) and lower fat ($P < .001$), usual food choices ($P < .001$), and dietary knowledge of fat ($P < .05$) but not for the consumption of fruits, vegetables or fat were reported.¹⁶⁴ A limitation of this study is the short duration of exposure to the nutrition education. One month may not

be long enough to produce a measurable behavior change. Nutrition education is a process of acquiring knowledge and observing practices and continually testing knowledge by putting it into action before dietary changes become habits. This process takes time and therefore longer interventions are needed to assess behavior change.

Yet another quasi-experimental study, which examined the effectiveness of an Internet/video-delivered program on the physical activity and fat intake in 103 low-income, ethnically diverse, middle school students, found positive changes in physical activity and fat intake¹⁶⁵. Students were assigned to intervention or control based on classroom. Those in the intervention group who were exposed to at least half of the eight Internet program sessions significantly ($P < .05$) increased exercise by 22 minutes compared to the control group. Those exposed to at least half of the sessions reported consuming significantly less fat ($P = .008$) post-test versus pre-test while the control group reported no significant changes.¹⁶⁵ This study and the previous two studies by Winett et al¹⁶³ and Long and Stevens¹⁶⁴ used a quasi-experimental design. This study design lacks randomization, which introduces the potential for selection bias. Surveys relied solely on self-report, which is a limitation. Also, the study was conducted over a short period (1 month) and included no follow-up to assess retention of knowledge and attitudes. Again the process of using knowledge to affect behavior change takes time; however, it is interesting to note that this short nutrition education programs did induce behavior change. Perhaps a short nutrition education program followed by follow-up messaging delivered via technology can help continue exposure and reinforce the information.

In another school-based study, Whittemore et al¹⁶⁶ examined the effectiveness of a school-based obesity prevention program delivered via the Internet. The program

included eight lessons covering nutrition, physical activity, metabolism, and portion control. Each online lesson included goal setting and self-management. In addition, participants had access to a blog maintained by a “coach” and they could interact with other participants. The study took place in three schools and 384 students, 62% girls, mean age 15.31 years, 38% overweight/obese at baseline, were cluster randomized by class into two groups (program or program plus coping skills training). There were no significant differences between groups for any weight-related variable at six months. However, there were significant ($P < .001$) positive changes in self-efficacy, healthy eating behavior, fruit and vegetable intake, physical activity, consumption of sugar-sweetened drinks, and sedentary behaviors within groups. Based on these results, the authors reported that programs delivered via the Internet might have the ability to impact health outcomes of adolescents in a positive direction.¹⁶⁶ One limitation was the lack of a control group. It is possible that the within-group changes were due solely to the nutrition education, but lacking this control it is difficult to conclude technology itself impacted any health outcomes. While this study was conducted over a 6-month period, longer than previously mentioned studies, it is still considered short-term.⁸² Furthermore, exposure to the intervention was short (eight sessions). This timeframe may not provide enough time for the acquisition and development of skills related to weight loss.

Other adolescent, web-based intervention studies have shown significant between-group differences in physical activity knowledge¹⁶⁷ or body fat,¹⁶⁸ while others have shown positive changes in dietary¹⁶⁹⁻¹⁷⁴ and physical activity^{169,170,173} behaviors, physical activity self-efficacy,¹⁷⁵ and weight as measured by BMI z-score.^{176,177} Taken as a whole Internet-based nutrition education programs have resulted in positive changes in

some aspects of nutrition knowledge and healthy behaviors. However, comparing results across studies is difficult due to differences in methodology including size, location (home vs. school), variables of interest, duration, and type of exposure to the technology component, and testing methods used. Future research in this area should include studies that are larger, longer term, and include low-income and more ethnically diverse populations. In addition, the identification of best practices for incorporating technology in nutrition-related programs would help create consistency across technology studies and ultimately make it easier to assess the success of the technology component in these web-based studies.

2.3.3 Cellphone-Based Studies

Although invented over 40 years ago, cellphones, as we know them today, are relatively new forms of technology and work as mini portable computers. Nollen et al¹⁷⁸ conducted an intervention to examine the effect of a mobile app designed to prevent obesity in low-income, race/ethnic minority adolescent girls (9-14 years old). The 12-week program included information on fruits and vegetables, sugar-sweetened beverages, and screen time. Fifty-one participants were randomized to either the intervention arm (n=26) or control (n=25). The intervention included educational content delivered via a smartphone app. Those in the control group received manuals outlining the educational materials. Participants in both groups showed positive changes in consumption of fruits and vegetables and sugar-sweetened beverages; however, these changes were not significant within or between groups. Changes in BMI were not statistically significant in either group. Authors noted, at the time of the study, that this was the first attempt to look at the effect of a mobile app only obesity prevention program on behavioral outcomes.¹⁷⁸

While results showed some positive trends in fruit and vegetable and sugar-sweetened beverage consumption, owing to the short duration of the program and small sample size, it was difficult to see changes in BMI.

In another intervention, Smith et al¹⁷⁹ developed the Active Teen Leaders Avoiding Screen-time (ATLAS) program. This was a school-based obesity prevention program designed for low-income adolescent boys (12-14 years old) that focused on psychological well-being through a reduction in excessive screen time, increase in physical activity and reducing consumption of sugar-sweetened beverages. The program included interactive physical activity sessions, one-on-one mentoring session, seminars, a website, a smartphone app, and strategies for parents to help reduce screen time. The smartphone app provided a way to self-monitor goals and behaviors and a way for researchers to communicate tailored motivational messages. A computer website, with the same information as the app, was created for those without a cell. Boys at-risk for obesity were enrolled into the study. Those assigned to the intervention (n=139) participated in the ATLAS program over the course of 20 weeks while the control group (n=154) received only the usual physical activity lessons taught at school. Both control and intervention groups were assessed at baseline and 8 months. Overall, there were no significant changes in body composition (BMI, waist circumference, or the percentage of body fat) or activity level. Those in the intervention group who were overweight/obese at the initial assessment did show positive changes in body composition, but these were not statistically significant. However, positive changes in fitness (upper body endurance) and decreased consumption of sugar-sweetened beverages was significant for those in the intervention ($P=.04$ and $P<.001$, respectively).¹⁷⁹ Results of this study stand in contrast

to a pilot study (N=100) conducted by the same researchers in which the intervention group showed significant ($P<.001$) positive changes in body composition (BMI and BMI z-scores).^{179,180} Again this outcome shows the inconsistent findings across adolescent studies. As with most studies involving technology, it is hard to identify the real effect of the technology component (smartphone or website) as the technology is just one of many elements of the intervention. This is a major limitation across technology-based studies.

2.3.4 Social Media and Text Messaging Studies

Social media is a common form of communication and networking for adolescents; however, little research has examined how social media can be used to collect or disseminate nutrition information for adolescents.^{181,182} A 2013 qualitative study by Woolford et al¹⁸³ did assess participants' (11 adolescents, and 13 parents) attitudes toward using a Facebook group as part of a weight management program. Most viewed a Facebook group as a positive addition to a weight management program; however, privacy, or the need to keep the group 'secret' was an important theme that emerged. Adolescents and parents were concerned that others outside the group would potentially see sensitive information. Other themes included setting rules and guidelines and monitoring the site so that users would have boundaries regarding what could and could not be posted. Participants wanted the Facebook page to include tips and recipes, chats/discussions, quizzes related to program knowledge, and an incentive system (points for completing tasks) that would be visible in graphic form on the Facebook page.¹⁸³ This study was small and only assessed participants' attitudes toward participating and not actual use of a Facebook page. More qualitative studies are needed to help researchers understand how adolescents are interacting with social media for nutrition and food

information and what role social media can provide to help communicate nutrition and food-related information. Interventions are also needed to see if social media can impact positive changes in dietary intake.

Much like social media, text messaging is an informal method of communicating that appeals to adolescents.¹⁸⁴ Text messages allow for short (160 characters or less) abbreviated communication. Acronyms and emoticons (emojis) are often used in place of words to convey information as well as feelings. Few studies have assessed the effect of text messaging on dietary habits of adolescents.¹⁸² A 2008 pilot study examined the feasibility of using a text messaging program for monitoring healthy behaviors among 58, 5-13-year old children.¹⁸⁵ Fifty-eight family groups, consisting of a child and a parent, were randomly assigned to text messaging, paper diary, or control conditions. All participants completed three 90-minute, in-person educational sessions focused on healthy behaviors (increasing physical activity, decreasing sugar-sweetened beverage consumption, and screen time). All family groups set goals for the program and those in the text messaging and diary group received pedometers to record steps. Each family group was asked to send one text per day regarding self-monitoring of goals for the duration of the 8-week study. Those in the diary group used paper forms to self-monitor; the control group was not asked to self-monitor. From baseline to follow-up, the text and diary group both increased exercise (self-report and pedometer) and reduced consumption of sugar-sweetened beverages. The control group self-reported less exercise at follow-up but also decreased consumption of sugary beverages. Despite the small size, the technology component was more acceptable to participants than the diary and was considered a feasible method to assess self-monitoring.¹⁸⁵ However, the parent interaction

biased the results as it is possible, particularly with the youngest children, that the self-reported results were input by the adults. Therefore, it is difficult to discern if the technology vs. the diary is easier for adults or children. This was a feasibility study and included young children and parents, thus such results cannot be generalized to older adolescent populations. While text messaging is a common form of communication for adolescents, additional research is needed to see if text messages are more effective at communicating messages or gathering information from adolescents and if adolescents would continue to text if required vs. simply texting for fun.

In yet another pilot study, researchers examined the use of text messages among 16-21 year-olds.¹⁸⁶ In this study, participants were randomized into a text message group (n=45) with 1 month of messages, or a control group (n=45) that received a pamphlet with information on healthy eating and physical activity. The text messages included motivational messages, texts to check in on nutrition and physical activity goals previously set by participants, and texts to check that the messaging system was functioning correctly (logistical check-ins). Both goal and logistical check-ins required participants to text back a response. For example, the originating message may have asked “Did you meet your health goals today?” and participants were asked to text back to indicate their response “A=just nutrition, B=just exercise, C=both, D=neither”. No changes in the outcome variables of interest (BMI, glycemic control, or self-efficacy) were noted; however, 93% of those in the text group indicated that they worked toward their nutrition and physical activity goals. Also, 71% felt the program helped them follow their goals, and 67% indicated messages helped them feel motivated to be healthier.¹⁸⁶ These are important findings because behaviorally-based programs (e.g., goal-setting)

can lead to better health outcomes.⁸² This was a short study (1 month), based on self-report and participants in the control group were not asked to track their progress in achieving goals. Therefore, it is not possible to determine the effect of this self-monitoring behavior between groups. Longer studies and interventions that are consistent in comparison are needed to assess the true relationship between technology and desired outcomes.

A few studies^{184,187} have used focus groups to identify effective ways to engage adolescents in texting for health. In one study, 145 participants (12-18 years-old) in Arizona were recruited from a diverse range of youth programs.¹⁸⁴ Participants expressed a dislike of terms such as “always” or “never” and liked messages that did not “tell” them what to do. Instead words such as “try” or “consider” were recommended.¹⁸⁴ In contrast, in another study, which included overweight/obese adolescents (N=24), participants wanted direct messages that told them what to do.¹⁸⁷ Tailored messages were preferred in both studies because they were thought to be personal and relevant.^{184,187} Texts that elicited a response (required the participant to text back an answer) were also viewed favorably¹⁸⁷ while random facts such as “Carrots were originally purple in color” were seen as fun.¹⁸⁴ Although specific participant characteristics were not thoroughly described in these two studies, the aforementioned outcomes showed consistency across groups in several of the findings. These findings can help researchers develop more appropriate and meaningful text message. In fact, conducting qualitative research with adolescent representatives of the target population may be a best practice for developing a text message-based program. However, one significant difference between the two studies is the use of direct messaging. Participants (overweight/obese adolescents) in the

study by Woolford et al wanted to be told what to do regarding nutrition and physical activity,¹⁸⁷ while participants (weight-related information not provided) in the first study,¹⁸⁴ wanted less direct terms. This is an area that needs more research as weight-loss messaging may need to be different than messaging directed at weight-gain prevention and the messaging may differ based on the characteristics of the population.

2.3.4.1 Summary

Research in the use of technology to change dietary behaviors in adolescents is beset by many limitations, including the short duration of programs, small sample size, inconsistent study design, wide variety of technology and non-technology-based program components, and few studies that fully report demographics or include low-income or diverse multi-ethnic populations. The last of these represents a significant gap in the literature. The prevalence of obesity differs greatly across income levels, and race/ethnic minority groups and low-income groups are disproportionately affected.^{188,189} However, lower income and race/ethnicity may be less of a barrier to accessing technology than once thought.¹²

Changes in eating behaviors are important elements of obesity prevention programs particularly for adolescents who are still developing their lifelong eating plans. However, equally important is a focus on FL skills. Most of these programs did not included aspects related to building these critical skills. More focus on these behavioral aspects and how technology (websites, cellphones, social media, and texting) can help bring attention and ultimately positive changes to adolescents' abilities to plan and manage, select, prepare, and eat food is critical. In addition, creating technology-based

programs that are not just developed to address the assumed needs of adolescents, but directly influenced by adolescents' input are needed.

2.4 Community-Based Participatory Research

2.4.1 Background

Community-Based Participatory Research (CBPR) is an approach that involves community members and stakeholders in all phases of a research project, including identifying what to research as well as designing, implementing, analyzing, evaluating and communicating research results.¹⁶ CBPR is a process of sharing ideas that benefit both community members and researchers alike because it places value on mutual decision making, builds relationships, and empowers community members to be the driving force for activities that happen within their community.¹⁶⁻¹⁸

CBPR evolved from research where participants were viewed as “subjects” on whom programs were “performed.”¹⁹⁰ In this traditional research process, academics and researchers set themselves apart as experts who knew what was best for subjects and communities.^{190,191} This dynamic led to a power imbalance and mistrust by community participants because they had very little voice in what happened either to themselves or their communities. There are several definitions of CBPR.^{18,192,193} Common to all definitions is the importance of giving voice to participants and empowering them to help identify and implement strategies that work within their context-specific environments.¹⁹¹

CBPR can be thought of as phases of research.^{17,18,194} The phases follow the general outline of the scientific method; however, they include a strong emphasis on the development of the relationship between researcher and community partners (Appendix A). While CBPR strives to include participants in all phases of the research process, this

is not always feasible or possible. A review of the use of CBPR with children and adolescents found, out of 56 studies that indicated involvement in at least one phase of the research, only ten included youth in all five phases, and five included youth in just one phase.¹⁷ Most often participants were involved in two to four phases (41 studies). Participants were most likely (84% of studies), to be included in developing actionable plans (Phase 3) and 44% of studies included participants in assessing key areas of need (Phase 2). More than half (59%) of the studies indicated the creation of an advisory board during Phase 1 to guide the development of the research.¹⁷

The use of CBPR is becoming more popular. A recent PubMed search on the terms “Community Based Participatory Research” and “adult” or “adults,” located 1401 articles. However, when this same search substituted “adolescent” or “adolescents” for adults, only 686 articles were identified. When “nutrition” was added as a search term, only 34 articles were found. Review of the articles revealed that only ten were truly related to adolescent health.^{184,195-203} Yet, as pointed out by Litt in a 2003 editorial,¹⁹⁰ The Society for Adolescent Medicine Guidelines for Adolescent Health Research recommends the involvement of adolescent community members in the research process. While we have begun to see a paradigm shift in research methods this change may be slower with younger age groups.^{190,204}

Several reasons are limiting the move to CBPR methods when working with adolescents. First, the very nature of the relationship between adult and child is an inherent power dynamic.¹⁷ This relationship is difficult to overcome for some researchers and adults. Second, researchers may be hesitant to use CBPR with this age group as the prevailing thought has been that children and adolescents will not be able to understand

the research. The question, however, is not what children can understand, but how they can understand it (i.e., how they can understand the information in a contextually relevant way).¹⁷ For example, a child may not be able to comprehend the many highly complex mechanisms that lead to overweight/obesity, but they can understand that few fruits or vegetables are available in their neighborhood or that their school sells only sugar-sweetened beverages. Despite these barriers, CBPR has been used with adolescents in several nutrition-related studies.

2.4.2 Community-Based Participatory Studies

Adolescents are making decisions every day about what they eat. Therefore, understanding how to read and interpret food labels is important, yet little research has been done with adolescents in this area.¹⁹⁵ A 2015 CBPR study examined the influence of point-of-purchase calorie labeling on food choices of adolescents in a school environment.¹⁹⁵ While the study clearly stated the use of CBPR in the title, no phase of CBPR could be identified from the information provided. The process lacked real collaboration. Rather, point-of-purchase calorie amounts were posted, participants were interviewed to extract key themes, and information was compared to gross consumption.¹⁹⁵ The very essence of CBPR is a collaborative process, a critical point that seems to be missing from the article and reinforces the notion that CBPR is often mislabeled or misinterpreted.

A study by Kerpan et al¹⁹⁷ did indeed use CBPR in developing an understanding of the determinants of diet for low-income, Aboriginal youth (14-21 years-old) in a school environment in Canada. The primary researcher spent a year with the community prior to data collection. During this time many people within the academic community

(youth, teachers, and administrators) expressed concern for body weight issues. Based on the community's identification of an area of need, the researcher worked with youth to identify themes. Ideas were shared, reviewed and verified with youth to assure information was correctly interpreted and understood.¹⁹⁷ In this way, the community's cultural beliefs, needs, and barriers to healthy eating became the focus of the intervention and solutions that addressed these issues were ultimately incorporated into the recommendations. However, this study did not discuss how changes were implemented based on the findings. Instead, the authors only made recommendations for future action. Nutrition-based CBPR studies that take the initial findings, implement them into plans, and evaluate the outcomes are needed.

Similar to Kerpan et al,¹⁹⁷ Sussman et al¹⁹⁸ employed CBPR in the development of weight-management materials for race/ethnic minority high school students in New Mexico. The researchers had a long-standing relationship with the community, and collaborative partnering (including with students) was used in all phases of the project. Several key themes related to weight management included media use (with adolescents identifying the Internet as a major source of health information and entertainment), focus on a "functional" definition of health (i.e., how it affects one's ability to engage in activities), and environmental barriers (availability of healthy vs. unhealthy foods).¹⁹⁸ Study size was a limitation as only seven students, 57% female, were included; however, qualitative research often has small sample sizes. Findings from this study align with previous research that has identified the Internet as a growing source of health information. In the U.S., approximately 8 in 10 Internet users look for health information

online,²⁰⁵ and across the country and around the world health information is available to anyone with a computer or cellphone.

Another study used a similar CBPR approach to engage adolescents in a Photovoice project.¹⁹⁶ The project focused on understanding the experiences of youth who used a neighborhood community center. By employing a CBPR approach, researchers sought to better understand the needs of youth in order to focus health programing. The authors noted that youth are not often given the opportunity to voice their experiences and share how the environment influences their lives and choices. Many themes emerged, including the food environment and the lack of tools available for youth to address concerns such as food advertisements, lack of access to healthy foods, and an abundance of unhealthy foods. Addressing environmental barriers as well as issues such as low FL would be beneficial for the health and well-being of adolescents.¹⁹⁶ FL focuses on building food-related skills including planning and managing, selecting, preparing, and eating. As such it is an innovative method to empower youth to navigate the cumbersome food environment to select healthier options.

In yet another qualitative study utilizing CBPR, researchers used the approach to help inform the development of nutrition and physical activity-related text messages for teens.¹⁸⁴ While the “target audience” (i.e., teens) was not involved in all phase of the study, they were integral in helping identify messages that would be meaningful to other teens like them. This intervention was an iterative process in which the teens helped develop and test the texts. Key findings included a preference for text messages that included facts (e.g., how many teaspoons of sugar in can of soda) and questions (e.g., what do you eat for lunch). After the initial development of the messages, an 8-week pilot

study (N=32) was conducted to further assess the acceptability of messages. Overall participants enjoyed the messages, although some indicated familiarity with the content made them “boring” indicating a need to develop even more original and inventive messages.¹⁸⁴ A limitation of this study is participants in the pilot were given a cellphone with unlimited text, which may have biased the results. It is possible that using a study phone is different from using one’s own phone, particularly with a personal phone with a limited text plan. Also, very little demographic data were collected so it is difficult to generalize these themes to other populations. Despite these limitations, using a CBPR approach with adolescents to develop and test text messages is important for researchers designing text-based programs. After all, who could be better at helping to develop nutrition- and physical activity-related text messages than the adolescents who will receive the messages.

In a novel use of CBPR, researchers developed *Students for Nutrition and Exercise* (SNaX), a 5-week school-based CBPR influenced obesity prevention program.²⁰² The objective of the program was to encourage students to select healthier school lunch options. Students were part of an advisory board that helped inform program development, and they were also recruited as peer leaders and advocates for the program. As peer leaders, they were asked to promote the program to others in the school. A total of 399 students from the intervention school completed pre- and post-test surveys. Those who were peer advocates (n=140) reported significant positive changes in attitudes toward cafeteria foods ($P=.003$) and consumption of sports/fruit drinks ($P=.06$) at post-test. While non-peer advocates (n=259) showed no significant changes, they did report positive changes pre-/post-test in cafeteria attitudes and consumption of sports/fruit

drinks, perhaps a positive impact of the peer group on the non-peer group. In further analysis, a comparison school was selected, and point-of-sale receipts from the cafeteria were compared to the intervention school. Findings indicated that servings of foods such as fruits and healthy entrees decreased in the comparison school but increased significantly ($P < .001$) in the intervention school.²⁰² While the findings appear positive there were differences at baseline in food selection and overall participation in the lunch program between the two schools. Controlling for these factors would provide a clearer picture of results. Furthermore, no demographic information for participants was provided, although both schools were selected from the Los Angeles Unified School District. While it is not possible to imply an actual effect on nutrition or food/eating-related outcomes, the incorporation of a CBPR approach may help increase the acceptance of healthy messages when they are delivered to and from peers.

2.4.2.1 Summary

The majority of the CBPR food-related studies presented above are qualitative. While qualitative studies are important in understanding attitudes and motivations of participants and guiding the development of program elements, they cannot provide evidence of behavior change. Additional CBPR studies are needed to examine the impact of CBPR food-related programs on changes in dietary behaviors. CBPR is a process or an approach to conducting research, and as such, it can only provide guidance in constructing the atmosphere in which the research is conducted. CBPR is not a theory or model on which the elements of a program can be based. For this approach researchers must look to behavioral theories and concepts that align with the premise of CBPR. SCT and FL are potential candidates for the job. SCT seeks to identify benefits and barriers in

an individual's environment and develop ways to influence these factors to build self-efficacy. FL strives to expand an individual's understanding of food to empower them to make healthy food choices.

Although it is not always feasible to include CBPR in every step of the research process, including participants in an advisory group is important and supported by previous research.^{17,206} The use of CBPR with adolescents is not well studied, and more research is needed on the use of CBPR for nutrition-related adolescent programs specifically. Adolescents are neither biologically children nor fully matured adults, and as such, they are often at unique developmental and biological crossroads for health.^{10,11} Adolescents are testing and developing decision-making skills, they have a desire to try new things, and they are reward-motivated.⁸ Because CBPR is a unique collaborative process that gives voice to those involved, provides participants the opportunity to make an important decision, and rewards the participants with the power to make lasting change it can be an ideal research method to use with this population.

CHAPTER 3

PURPOSE OF THE STUDY

3.1 Study Objectives

Interest in food literacy (FL) as a means to understand and influence the obesity epidemic is growing. However, the connection between FL and technology has yet to be fully explored. Therefore the overarching study objectives are to 1) Perform a systematic review of the literature to synthesize what is known regarding the use of technology in FL interventions for adolescents (Study 1); 2) explore the role of community-based participatory research (CBPR) in developing and implementing a technology-driven FL program for adolescents (Study 2); and 3) investigate the use of a technology-driven FL program to positively change adolescents' knowledge, attitudes, and behaviors toward fruits, vegetables, sugar-sweetened beverages and physical activity (Study 3).

3.1.1 Conceptual Model

The conceptual model for this study positions FL (i.e., a FL program for adolescents) as an input and nutrition-related knowledge, attitudes and behaviors as outcomes. The model also includes community-based participatory research and technology as influences on the design of the FL program. In addition, because gender may be an influencing factor on nutrition-related outcomes it has been represented in the full model and analyzed in the third study (Appendix B). Each of the three studies is designed to examine a portion of this model. Study 1, a systematic review assessed the current literature to determine if there are any FL studies currently using technology and if so is there a positive effect on nutrition knowledge and dietary consumption (Appendix

C). The second study was completed in two phases. Phase one employed the use of CBPR to gather the feedback of adolescents regarding the outline for a technology-driven FL program. Based on the information from phase one, the program materials were refined. In phase two, a pilot version of the program was implemented and evaluated for pre- and post-intervention changes in nutrition knowledge, attitudes and behaviors (Appendix D). The final study was completed in phase three and took a more comprehensive view of the conceptual module and included a technology-driven FL program as the input and nutrition-related knowledge, attitudes, and behaviors as outcomes. In Study 3 the outcomes were analyzed by gender and associations between the variables were examined (Appendix E).

3.1.2 Specific Aims and Research Questions

Study 1 – Systematic Review

Title: What’s Technology Cooking Up? A Systematic Review of the Use of Technology in Adolescent Food Literacy Programs

Specific Aim 1.1: To systematically assess the literature to determine which adolescent FL programs are incorporating technology.

Research Question 1.1: Are there technology- driven FL programs which use the concepts of planning and managing, selecting, and preparing food?

Specific Aim 1.2: To identify how technology is used in these programs and examine dietary intake outcomes to determine the specific effectiveness of technology-driven components.

Research Question 1.2: Do technology-driven FL programs lead to increased knowledge and improved dietary behaviors?

Specific Aim 1.3: To examine the usability and/or acceptability of technology-driven FL programs.

Research Question 1.3: Do adolescents like technology-driven FL programs?

Study 2 – Qualitative

Title: “*Just Say It Like It Is!*” Use of a Community-Based Participatory Approach to Develop a Technology-Driven FL Program for Adolescents

Specific Aim 2.1: Collect and implement the recommendations of adolescents regarding the delivery of a FL program.

Research Question 2.1: How will adolescents’ recommendations influence the development and implementation of a FL program?

Specific Aim 2.2: To explore the potential of technology to influence adolescents’ participation in a FL program

Research Question 2.2: In what ways can technology be used to deliver food-/nutrition-related information to adolescents participating in a FL program?

Study 3 – Quantitative

Title: *FuelUp&Go!* A technology-driven FL program to change adolescents’ knowledge, attitudes, and behaviors toward fruits, vegetables, sugar-sweetened beverages and physical activity.

Specific Aim 3.1: To investigate the changes in adolescents’ pre- and post-intervention food-related knowledge.

Research Question 3.1: Upon completion of the FL program, will participants express a positive change in food-related knowledge as measured by pre- and post- intervention surveys?

Specific Aim 3.2: To use the Social Cognitive Theory constructs of outcome expectations and self-efficacy to investigate the changes in adolescents' pre- and post-intervention attitudes toward fruits and vegetables, sugar-sweetened beverages, and physical activity.

Research Question 3.2: Upon completion of the FL program, will participants express a positive change in outcome expectations and self-efficacy regarding the consumption of fruits, vegetables, sugar-sweetened beverages, and participation in physical activity, as measured by pre- and post- intervention surveys?

Specific Aim 3.3: To explore the potential of a technology-driven food literacy program to influence adolescents' consumption of fruits, vegetables, sugar-sweetened beverages and participation in physical activity.

Research Question 3.3: Will adolescents enrolled in a technology-driven food literacy program exhibit positive changes in consumption of fruits, vegetables, and sugar-sweetened beverages and participation in physical activity, as measured by pre- and post-intervention surveys?

3.2 Rationale and Significance of the Study

Adolescent overweight/obesity is a serious and growing public health concern. While the cause of overweight/obesity is multifactorial, the poor dietary habits of adolescents have led researchers to investigate methods to increase knowledge, improve attitudes, and change dietary behaviors of this important population. Current nutrition education programs have had limited success and therefore new approaches are needed to examine the complex relationship between food-related knowledge and dietary behaviors.

FL is a newer term that is gaining popularity as a potential mechanism to increase food-related knowledge and change dietary attitudes, as a means to increase the capacity to engage in healthy eating behaviors. However, there remains a gap in the literature regarding the use of FL programs to influence dietary change in adolescents. While cooking programs can encompass the four domains of FL, they are by no means the only way to incorporate these elements into a program. In fact, cooking programs may be limited to locations that have kitchen facilities and often these facilities do not represent the actual home environment. Cooking up new methods to increase FL, which include best practices such as taste tests and hands-on food experiences that also includes innovative ways to encourage participants and engage adolescents in content, are needed.

Adolescents are digital natives, and nutrition-related programs have used various forms of technology as a media outlet to deliver program content to this population with mixed results. However, technology is quickly changing and new methods to engage adolescents are emerging. The pervasive use of cellphones by adolescents and the potential to reach lower-income and racial/ethnically diverse populations via this method is encouraging and warrants additional research. Currently, no previous research has been found that examined the use of a technology-driven FL program for adolescents. Planning a program and engaging participants in program activities are two important issues that must be addressed, and innovative methods are needed to facilitate this process.

The use of CBPR in adolescent studies is limited. However, the nature of this approach may be ideally suited to the unique developmental stage. Adolescence is a time when decision-making skills are cultivated. Collaborative decision-making is central to

the CBPR process and therefore an ideal means to help adolescents develop these skills and encourage them to voice opinions on the decisions that affect their lives and environment. An adolescent CBPR informed study can strengthen program components and make the information more relevant to the adolescents who will ultimately participate.

The ability of a CBPR informed technology-driven FL program to influence the dietary knowledge, attitudes, and behaviors of adolescents has yet to be studied. This research helped to identify gaps by adding to the understanding of the use of fun and innovative programs and ideas to engage adolescents in healthy eating. Food is complicated. Perhaps the understanding of dietary knowledge, attitudes, and behaviors will be simplified by 1) looking at it through a different lens (i.e., FL); 2) using innovative technology as a means to reach challenging populations (i.e., adolescents); and 3) utilizing an approach (i.e., CBPR) to engage participants in the process of designing and implementing program content.

3.3 Program Overview

In Springfield, MA approximately 42% of children are overweight or obese.²⁰⁷ This percentage is higher than the statewide (32.3%) and national average (33.6%).^{21,207} In addition, only 14% of MA youth reported eating the daily recommended number of fruits and vegetables, 71.7% drink at least one sugar-sweetened beverage daily, and 77% are not meeting the recommended 60 minutes/day of physical activity.^{36,208} The dietary and physical activity habits of adolescents have been targeted as key areas to improve.³⁹

FuelUp&Go! is a theory-based technology-driven FL program developed for adolescents in the Springfield, MA area. The outline of the program was guided by the

obesity prevention program *Strength and Power In Nutrition* (SPIN) developed by Elena Carbone and Jean Anliker of the UMass Nutrition Department.²⁰⁹ SPIN promoted healthy decision making through consumer awareness and included: hands-on activities, presentations, physical activity, and taste-tests of recipes. *FuelUp&Go!* is guided by Social Cognitive Theory (SCT). SCT was developed by Bandura as a means to understand how individuals behave in a social environment.⁶⁶ The theory describes a mechanism of how people make decisions and the processes by which individuals are influenced by internal and external environmental factors. SCT describes the process by which people internalize external factors to fit their needs. The constructs of SCT can be categorized into five groups: psychological determinates of behavior, observational learning, environmental determinants of behavior, self-regulation, and moral disengagement (Appendix F). The concepts of outcome expectations and self-efficacy fall within the category of psychological determinants of behavior. These concepts can help researchers understand how individuals place values on decisions and actions. Decisions and actions are subjective, and people work to make meaning of these practices within the context of their lives. They operationalize what they know and feel, and are influenced by their outcome expectations, perceptions of what a likely outcome will be if they act. A person's outcome expectation may be motivated by perceived benefits and barriers of the outcome taking place. For example, an individual may consider the benefits of eating vegetables (e.g., taste good) against the obstacles (e.g., time to prepare) as he or she decides if the expected outcome (health) is a likely result. Within the SCT model, self-efficacy is viewed as an individual's confidence in his or her ability to

perform a behavior. The more confidence an individual has, the greater the potential that he or she will engage in the behavior.⁶⁶

SCT has been used in the development of other FL programs as a means to understand mechanisms of change in attitudes and behaviors.^{144,145,149,150} In a review of FL programs by Brooks and Begley,¹⁵² the authors indicated that SCT may be ideally suited to programs for adolescents as the theory focuses on determinants (internal and external) that affect personal food choices. Adolescents are at a cognitive stage in which they are developing skills to make choices.⁸ SCT may help develop a better understanding of the motivations of adolescents to make dietary choices.¹⁵² Therefore, the concepts of outcome expectations and self-efficacy were used to help understand behavior change.

From May through August of 2015, lesson plans from SPIN were reviewed and edited to fit the theme of *FuelUp&Go!* and to meet the time allotment of 1-hour. In addition, technology components (fitness tracker, website, and text messages) were integrated into the material. Through several meetings with the program coordinators at the Greater Springfield YMCA a plan was developed to implement the program in Fall of 2015. In addition, to help develop a program that was specifically designed for adolescents in the Springfield area it was agreed that using a community-based participatory approach would be helpful in engaging adolescents to participate. In August 2016, an advisory group of adolescents from the Springfield area were recruited to participate in a Kid Council (KC) (Appendix G). The KC provided guidance on program content including activities, text messages, recipes, and surveys. Based on the feedback

from the KC, an initial program outline including scripts, handouts, and recipes was developed for a six-session program (Appendix H).

To assist with implementation of *FuelUp&Go!*, an independent study was developed for University of Massachusetts Nutrition Undergraduate Students. Twelve students, five for Fall 2015 and seven for Winter/Spring 2016, were recruited as Program Assistants. All Program Assistants completed Human Subjects Training prior to working with program participants.

In Fall of 2015, a pilot version of *FuelUp&Go!* was conducted. Participants were recruited from the North End Outreach Center a satellite location for the Greater Springfield YMCA. To join, participants had to be between 11 and 15 years old, have a cellphone or mobile device such as a tablet, provide signed consent forms from a parent/guardian and assent to participate by signing an assent form (Appendix I and J assent and consent forms). At the first session, participants were asked to complete a pre-assessment survey including a youth and adolescent food frequency questionnaire (YAQ)²¹⁰ and a knowledge, attitude, and behavior questionnaire adapted from the Wisconsin Farm to School Evaluation Knowledge, Attitude, and Behavior Survey²¹¹ and from information gathered on ChooseMyPlate.gov²¹² and the American Heart Association²¹³ (Appendix K and L). All participants completing the forms were also given an UpMove™ tracker and shown how to setup an account in the associated UpMove™ app. In addition, participants were informed that they would receive weekly text messages and were shown how to access a website created for the program (Appendix M). Each of the six sessions covered a special topic, and included food clues, healthy tips, hands-on activities, physical activity, and a taste test of a recipe (Appendix

N-R). At the end of each session each adolescent received a take-home bag packed with a food item related to that day's discussion as well as recipes, fun food facts, and a \$5.00 gift card. At the last session, participants completed post-YAQ and Knowledge, Attitude, and Behaviors Surveys. In addition, they were asked to complete a program evaluation form (Appendix S).

At the conclusion of the pilot sessions, the program facilitator and program assistants met to discuss delivery and content. Based on observations, field notes, and participant comments, adjustments were again made to the content and delivery of the program. For example, text messages were reviewed and modified, the order of topics was rearranged, and based on time constraints activities were edited. Changes were also made in the evaluation tools used as pilot participants experienced difficulty filling out the forms. Specifically, the YAQ was replaced with 13 questions from the Youth Risk Behavior Surveillance System (YRBSS) survey (Appendix T). The Knowledge, Attitude, and Behavior survey was revised and modified based on validated survey questions compiled by the Network for a Healthy California²¹⁴ to better reflect the SCT constructs of outcome expectations and self-efficacy (Appendix U). Additional details on methods, measures, analysis as well as adjustments and modifications based on KC and pilot feedback and observations are presented in Study 2. In November of 2015, a partnership was formed with *Project Coach* to deliver the program to participants in January and February 2016. *Project Coach* is a mentoring program for teens in the Springfield area and is facilitated by graduate and undergraduate students at Smith College. Through the program teens are empowered to become coaches and in turn, help mentor elementary school child in their own neighborhoods. Implementation of *FuelUp&Go!* began on

January 20th, 2016 and ran through February 24th, 2016. Sessions were conducted in the library of Chestnut South Middle School or at Smith College. Through our work with *Project Coach*, we connected with the Director of School Culture/Student Life at Chestnut South Middle School who asked us to develop *FuelUp&Go!* for their 7th grade students. The program was reorganized to meet the time constraints of the school day (45-minute class blocks) and the number of sessions was increased from six to eight to meet the needs of the school. The program began on February 24th, 2016 and concluded on April 13, 2016. Additional details regarding implementation of *FuelUp&Go!* with *Project Coach* and Chestnut South Middle School are presented in Study 3.

CHAPTER 4

WHAT'S TECHNOLOGY COOKING UP? A SYSTEMATIC REVIEW OF THE USE OF TECHNOLOGY IN ADOLESCENT FOOD LITERARY PROGRAMS

4.1 Introduction

Nearly 34% of adolescents are overweight or obese.²¹ Poor eating habits have been implicated in this problem and current dietary trends indicate that adolescents are not meeting dietary recommendations.²¹⁵⁻²²⁰ In fact, adolescents on average, consume only one (½ cup serving of fruits) and slightly more than one (½ cup serving of vegetables) per day.³ This is far below the current recommendations of 1 ½ - 2 cups of fruits and 2 – 3 cups of vegetables per day.²¹² Adolescents are also eating more foods away from home, particularly in fast food establishments.^{151,220-222} Due to the ready availability of prepared and prepackaged foods, the general population may undervalue the need for basic cooking skills.^{142,223,224} Despite an interest in cooking shows, food-related apps, and social media sites such as Pinterest, which heavily features food-related information, adults are cooking less and this has contributed to a lack of cooking skills passed from parent to child.^{225,226} Over time schools have also shifted away from conventional home economic courses.^{227,228} These courses traditionally provided students with basic life skills including a general understanding of how to plan and manage, select, prepare, and eat healthy foods. As a result, adolescents in the 21st century may lack the basic food-related skills needed to consume a healthy diet.

Innovative programing is needed to change this trend and help adolescents build lifelong healthy relationships with food. Traditional nutrition-related programs have often

taken a science-based knowledge approach to eating.¹⁴² This approach provides information centered on nutritional components such as macro or micro nutrients. These programs focus on building factual knowledge, but often lack skill-based or experiential learning, therefore, leaving a gap between the acquisition and implementation of knowledge.^{139,142} Food literacy (FL), which has grown out of the fields of health and nutrition literacy, is a relatively new concept that focuses on a person's ability to not only acquire food-related knowledge but use knowledge to achieve better dietary outcomes.^{7,132,133} The core constructs of FL revolve around the skills needed to navigate the food environment -- planning and managing, selecting, preparing, and eating healthy foods (Figure 1.1).^{7,130,132,133} A recent systematic review by Brooks and Begley¹⁵² noted that FL programs offer an important opportunity to reach adolescents at a critical point in their cognitive development. Adolescence is a time for developmental transitions in behaviors, particularly in decision making.¹⁰ Adolescents are seeking and testing their independence and learning to become self-sufficient^{206,229} therefore making it an ideal period for food interventions to help influence future eating habits. Previous FL programs for adolescents have shown positive, although not always significant, relationships between the acquisition of improved food-related skills and better dietary intake.^{141,147,150,219,230} While methodological differences make it difficult to compare study outcomes, several recommendations have been made for future research, including offering a minimum of four sessions,¹⁵² incorporating weekly themes,^{152,231-233} providing opportunities for hands-on learning,^{152,231} developing peer-modeling,^{202,234} and using technology to deliver a portion of the content.¹⁶⁴

Adolescents are digital natives and their use of technology warrants a deeper look at its use as a component of or a delivery method for FL programs. Currently, 92% of adolescents access the Internet daily, 87% have access to a computer, 58% a tablet, and 88% a cellphone.¹² Cellphone use has increased 13% between 2013 and 2015 and the number of adolescents using a smartphone during this time has increased 47%.^{12,235} The use of cellphones and other mobile technologies such as tablets may be driven by other factors, including the ability to use these devices for sending text messages and accessing social media sites.¹² An estimated 91% of adolescents use their cellphones for text messaging, sending an average of 67 messages daily.¹² Social media is also entwined in the lives of adolescents. Facebook is the most commonly used site, with 71% of all teens reporting use of this platform for communication.¹² Visually-oriented sites such as Instagram and Snapchat are also widely used, with 52% and 41% of adolescents visiting these sites, respectively.¹²

Previous research has shown limited success with the use of technology in traditional nutrition programs,²³⁶ although specific technology components such as video games have shown positive outcomes.²³⁷⁻²³⁹ These games -- often referred to as “serious” games -- combine elements of learning and play while developing new skills.^{116,240,241} The gaming environment is not only appealing to adolescents but provides a platform to deliver complex educational components in a fun and engaging way.^{116,242} Gaming also allows participants to virtually test out knowledge and skills in a safe environment while also providing opportunities to observe modeling of desired behaviors.¹¹⁶

4.1.1 Study Aims

Teens are clearly using technology for personal communication, but a question remains if technology can be successfully integrated into FL-related programs for this age group. To our knowledge no review has examined the use of technology in adolescent FL programs. Therefore, the primary aims of this review were to: 1) systematically assess the literature to determine which adolescent FL programs incorporate technology; 2) identify how technology is used in these programs; and 3) examine dietary intake outcomes to determine the specific effectiveness of technology-driven components. A secondary aim was to examine the usability and/or acceptability of the programs. The population, intervention, comparison, and outcomes (PICO) statement used to guide this review is available in Table 1.1.

4.2 Methodology

4.2.1 Sources and Strategy

A systematic examination of peer-reviewed literature following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines²⁴³ was undertaken from January through March 2017. Thirteen electronic databases were searched: Academic One File, Academic Search Premier, CINAHL, Cochrane Library, Engineering Village, Google Scholar, OVID, Proquest, Psyc Info, PubMed/Medline, Sport Discus, Science Direct, and Web of Science. The following key words were used alone and in combination to search each database: *FL, nutrition literacy, cooking literacy, culinary skills, food skills, and adolescent(s), teen(s), teens, teenager(s), youth(s), and technology, app, computer, smartphone, smart phone, online, web-based cellphone, cell phone, text, text message, SMS, website, and intervention, program.* A

reference librarian was consulted at the beginning of the search process to verify proper procedures and to assist with identifying additional databases. After the initial database searches were conducted, a hand search of references cited in relevant reviews was carried out, and a backward search of citations was also completed.

4.2.2 Study Selection

Articles were included if they were in English, published in the last 20 years, provided access to an abstract and full text, included the FL domain of eating (dietary intake) and at least one additional domain (planning and managing, selecting, or preparing healthy foods) as part of the program, used pre- and post-program assessments of knowledge and/or dietary intake, and included a primary target audience of 12-19 year olds. Articles were excluded if they did not meet inclusion criteria, included a population of >19 years old or information for those ≤ 19 could not be extracted from data presented, or if the program focused on a specific disease as the only primary outcome (e.g. diabetes, eating disorders, overweight or obesity). Additionally, studies were excluded if they were based on previously conducted studies and the information reported was similar. For example, a research report by Cullen et al²⁴⁴ was based on a previous 2003 study by Baranowski et al²³⁸ and included the same sample, sample size, and variables. The titles and abstracts of 545 articles were reviewed. Of these, 47 met the initial criteria and received a full text review, including 11 review articles. Review articles were included so that a hand search of references could be conducted. After excluding articles not meeting the inclusion criteria, a final sample of eight articles was selected (Figure 1.2).

4.2.3 Analysis

Each randomized control trial (RCT) selected for review was evaluated using an adaptation of Downs and Black's scoring system for assessing the quality of health care interventions.²⁴⁵ The categories assessed were: 1) randomization, 2) use of a control group, 3) how and if the technology was isolated from other components (e.g. was technology embedded within an in-person program), 4) use of pre- and post-test measures, 5) retention rate, 6) if analysis were performed to determine baseline group equivalents for control and intervention groups, 7) whether missing data were reported; 8) use of power analysis, and 9) if validated measures were used to assess study outcomes. Studies that did not include a control group were labeled as No Control interventions (NCI). NCI studies were evaluated using the same methods as the RCTs; however, in an effort to provide more relevant criteria, the *individual randomization* category was reclassified as *population source* and the *control group* category was reclassified as *no prior exposure*. Each category for RCT and NCI studies was awarded an equivalent score of 11.11 (100 divided by 9 categories). A study received a Yes (Y) response if it met the criteria for the category and a No (N) if information for that topic was not presented (Tables 1.2 and 1.3). If information was unclear or not fully described the category was marked as unknown (UK). All Y ratings received the full score of 11.11 and all N or UK ratings received zero points. High quality (++) studies scored between 66.67 and 99.99 points. Intermediate (+) and low quality (-) studies scored between 33.34 – 66.66 and 0 – 33.33 points, respectively. This categorization and system follows previously published methods.¹³ All articles were reviewed by CW and EC and discrepancies between ratings were discussed as needed until a consensus was reached.

4.3 Results

Eight articles, representing eight separate studies, met the search criteria, of which six^{164,238-240,246,247} were RCTs and two^{248,249} were NCIs (Figure 1.2). The studies selected were published between 2003 and 2016 and represent eight different peer-reviewed journals. Sample sizes varied from 53 to 1,578 participants. The age range of participants was included in seven^{164,238-240,247-249} of the eight articles and was between 8 – 16 years old. Information about gender was provided in six^{164,238-240,247,248} studies. Of these, three^{164,238,248} reported a higher percentage of females. One study included all males,²⁴⁷ the 2011 study by Baranowski and colleagues²³⁹ included more males than females, and Banos et al²⁴⁰ included an equally represented female/male sample. Ethnicity was reported in five studies^{164,238-240,247} and anthropometrics such as BMIz-score were included in five.^{239,240,246,247,249} Program duration ranged from 2 to 9 weeks for RCTs and 5 days to 6 months for NCIs. All but two studies^{240,249} took place in the United States (Table 1.4).

4.3.1 Design Quality and Ratings

The average rating of the eight studies was 58.33% (64.81% for RCTs and 38.89% for NCIs) (Tables 1.2 and 1.3). One study was scored as high quality (88.88%),²³⁸ six met the criteria for an intermediate quality,^{164,239,240,246,247,249} and one received a score of 33.33% indicating a low quality.²⁴⁸ The majority of RCTs (four out of six) did not randomize participants on an individual level; instead, participants were cluster randomized based on school^{238,240} or class/troop.^{164,247} In the 2003 study by Baranowski et al,²³⁸ randomized based on group (school), analysis was done on the group

level and therefore meets the criteria for individual randomization. Another study²⁴⁶ included both individual and cluster randomization. However, this study did not meet the criteria for individual randomization because it was not consistently applied. Information regarding sample size calculations was provided for four^{164,238,246,247} of the six RCTs; neither of the NCIs provided this information.

All RCTs included a control group although the type of control varied. The studies by Banos et al²⁴⁰ and Long and Stevens¹⁶⁴ included control groups that received standard treatment such as written information (pamphlets) or classroom education. Three studies^{239,246,247} employed a different type of technology for both the control and intervention group. For example, the 2011 intervention by Baranowski et al²³⁹ used serious games incorporating fantasy and action, which were designed to motivate behavioral change, while controls played simple knowledge-based games. Participants in the intervention arm of the study by Thompson et al²⁴⁷ used a website that focused on increasing fruit and vegetable consumption; whereas, the control group used a site geared toward improving physical activity. Intervention participants in the The Healthy Outcomes for Teens (HOT) program²⁴⁶ used an active learning website and control participants used a passive website. The 2003 study by Baranowski et al²³⁸ did not provide any instruction to the control group.

Retention rates were not clearly stated in any study; however, based on flow charts and sample size data provided, retention rates could be calculated for three RCTs^{239,246,247} and ranged from 84.5% to 100%. Baseline equivalence was conducted for all six RCTs; however, significant differences were noted by three^{239,246,247}; thus,

warranting a rating of No for these studies in this category. Neither NCI provided any baseline comparison or adjusted for differences among participants.

Pre- and post-tests were conducted in all studies. Previous validated measures were used or adapted for use in all RCTs and three studies^{164,240,246} provided details on internal consistency of measures. Despite this, all diet-related measures were self-reported and are therefore subject to response bias. In addition, social desirability bias can be a concern with questions related to dietary intake. Only two studies addressed the issue of social desirability bias by including a social desirability measure.^{239,247}

4.3.2 Technology Components

The mode of delivery of program content varied, with only two delivering the intervention solely through the use of technology.^{238,240} In the studies by Baranowski et al²³⁹ and Muzaffar et al,²⁴⁶ both the intervention and control groups used technology. Long and Stevens¹⁶⁴ and Thompson et al²⁴⁷ imbedded the technology within a larger multi-component intervention program. Technology components were isolated in the NCI study by Turnin et al²⁴⁹; whereas, Dixon et al²⁴⁸ included the technology portion within a larger program.

The types of technology used to access intervention components were similar across programs. Seven^{164,238-240,246-248} of the studies used Internet and web-based platforms and all of the RCTs^{164,238-240,246,247} incorporated game elements. While the majority of studies were Internet, web-based, or included games, the programs differed significantly in their themes, content, and approach (Table 1.4).

Three RCTs^{239,240,246} were designed as obesity or diabetes treatment or prevention programs; however, the outcomes were not solely disease specific and met the criterion

for inclusion in this review. Each of these RCTs included serious games to provide nutritional information, set nutrition-related goals and built nutrition-related skills.^{239,240,246} In addition, Muzaffar et al²⁴⁶ featured videos, and narration along with the games in their intervention. Baranowski et al's 2003 study²³⁸ also used games and activities to engage adolescents, and as part of these activities recipes were prepared in a virtual kitchen. Two additional programs incorporated online games.^{164,247} However, unlike the previously mentioned RCTs, the programs implemented by Thompson et al²⁴⁷ and Long and Stevens¹⁶⁴ included in-person education as well.

Neither NCI used games. Dixon and colleagues²⁴⁸ used a website to help participants develop meal planning skills through the use of a Menu Planning Plate activity. The site also allowed for two-way interaction so participants could ask questions and receive feedback from researchers.²⁴⁸ Finally, Turnin et al²⁴⁹ used a computer kiosk to collect menu selections from students. The kiosk was available in the cafeteria to help students select food items to create a healthy meal. Advice and information was provided to students based on their meal selection.

4.3.3 Food Literacy Components

All programs attempted to increase nutrition- and/or food-related knowledge; however only two^{240,246} actually measured this aspect. All studies incorporated at least one of three core concept of FL (planning and managing, selecting, and preparing food) within the technology component. The fourth construct of FL relates to eating healthy foods and all programs were food-related and designed to increase the consumption of healthy foods. However, this designation by itself does not define a program as FL-related, as many nutrition and food programs would fall within this criterion. Seven

programs incorporated information regarding the selection of food,^{164,238-240,247-249} three programs included elements related to planning and management,^{240,246,248} and three included activities to prepare food items.^{238,240,247} The study by Banos et al²⁴⁰ was the only one that included all four FL concepts; studies by Baranowski et al,²³⁸ Dixon et al,²⁴⁸ and Thompson et al²⁴⁷ included three. Of the remaining four interventions, only two FL constructs could be detected. Three incorporated aspects related to selection^{164,239,249} and one included components related to planning and managing.²⁴⁶ The measures used to assess program outcomes such as knowledge or dietary intake varied significantly across all studies and no study used a FL measure.

4.3.4 Dietary Outcomes

All studies reported beneficial food-related changes although the lack of consistency in measures makes it difficult to compare the findings. Five studies explicitly reported significant beneficial changes in food intake,^{164,238,239,246,247} two indicated improvements in the ability to select healthy foods,^{246,249} and two indicated the program influenced participants' intention to consume foods.^{240,248}

The 2003 study by Baranowski et al,²³⁸ reported a positive 1.0 serving per day change in combined fruit, juice, and vegetable consumption in the intervention group as compared to controls. Similarly, Thompson et al²⁴⁷ reported increased consumption of fruit and juice by almost one serving per day in the intervention group compared to the control group's one-half serving increase. This difference represents a significant ($P=.003$) increase over the control group. However, these group differences were not maintained at the 6-month follow-up.²⁴⁷

In the 2011 study conducted by Baranowski et al²³⁹ statistically significant ($P=.018$) changes in fruit and vegetable intake in favor of the intervention group were observed in the intervention group, relative to controls, over the course of the nine session program. Long and Stevens¹⁶⁴ also reported statistically significant group differences in self-efficacy for healthy eating for fruits and vegetables, lower fat, usual food choices, and knowledge of dietary fat. The study by Muzaffar et al²⁴⁶ did not find statistically significant group differences; however, statistically significant pre- to post-test changes ($P=.002$) were found for fruits and vegetables and fat consumption in both the intervention and control groups. In addition to dietary consumption, Muzaffar et al²⁴⁶ also assessed changes in meal planning skills and reported that in the intervention group, participants significantly ($P<.001$) improved their ability to select the correct portions of food for each food group, while the control group showed no change. Likewise Turin et al²⁴⁹ used participants' reported selection of foods to represent their self-reported ability to make a healthy food change.²⁴⁹ Overall Turin et al²⁴⁹ found participants had significant increases in the selection of dairy ($P=.03$), fruits and vegetables ($P=.05$), and starch ($P=.03$) by the end of the intervention.

Two studies focused on the ability of the intervention to influence eating habits.^{240,248} Dixon et al²⁴⁸ found that 72.55% of participants reported their vegetable consumption and 80.39% reported fruit consumption would be influenced by their planning of daily meals. However, this represents a decrease from pre-assessment. Despite this, at the end of the program participants indicated a small increase in consumption of vegetable (0.111 servings) and fruit (0.079 servings) per day if their meals were planned.²⁴⁸ Similarly, more than half (67%) of participants in the intervention

arm of the study by Banos et al²⁴⁰ reported beneficial changes in their food habits as a result of the program.

Additional information was reported in several studies, including significant intervention effects for nutrition knowledge ($P=.037$),²⁴⁰ self-efficacy for consuming fruits ($P=.068$)²⁴⁷ and fruits and vegetables ($P=.01$),¹⁶⁴ and meal planning skills ($P<.001$).^{246,248} Additionally, acceptability or usability of the program content was reported in only three studies.^{239,240,248} Fifty percent of participants in the study by Banos et al²⁴⁰ and 80-90% of participants in the study by Baranowski et al²³⁹ indicated they liked the program. Slightly over 84% of participants in the study by Dixon et al²⁴⁸ thought that the Menu Planning Plate was easy to use, and 80% thought they could use the plate to teach others about menu planning.

4.4 Discussion

Examining food through the lens of FL is gaining momentum and research in this area is growing. Indeed, without a solid foundation in planning and managing, selecting, and preparing food, it is difficult to expect an individual to consume healthy foods. While eating healthy food is challenging and is influenced by many factors, if whole foods are brought home without the knowledge and skills to transform them into nutritious meals and snacks, healthy eating is not an inevitable outcome. Traditional hands-on cooking programs have shown some success in developing the skills necessary to change eating patterns of young consumers.^{145,149,250-252} However, to make a lasting impact on health, large scale programs are needed that take advantage of technological advances to appeal to tech savvy adolescents.

Each of the programs in this review used a different type of technology; however six^{164,238-240,246,247} used serious games. These games are fun for users and engage them in play that provides experiential learning.²⁵³ One program, Squire's Quest, actually had users prepare meals in a virtual kitchen.²³⁸ This type of play exposes users to opportunities not always available in their real world and allows them to practice much needed food-related skills. Providing constructed environments to explore food-related scenarios as a virtual avatar is also important and was seen in five^{164,238-240,247} of the programs. The use of an avatar in a constructed environment allows the player to practice decisions and virtually experience an outcome.^{253,254} While this type of play is often used in games targeting high-risk, and sensitive subjects such as HIV/AIDS or safe sex,²⁵³ providing safe spaces to test choices and replay scenarios can be an important part of the health-related dietary decision making process for adolescents.

Food-related information also makes an appearance in some commercial web- or app-based programs designed for children and The Academy of Nutrition and Dietetics offers a list of six apps to help children learn about nutrition.²⁵⁵ Yet, children are often exposed to food in the form of non-nutrition related games that amount to little more than advertisements for unhealthy food.²⁵⁶ Indeed, in a study conducted by Moore and Rideout,²⁵⁶ of 77 food brand websites with a primary audience of 2-11 year-olds, 73% included a game that exposed participants to branded food items.²⁵⁶ Outside the research and clinical environments adolescents have few opportunities to interact with innovative food-related computer, Internet, or cellphone based technology aimed at increasing healthy food-based skills. This makes it all the more important to continue research into the connection between creative uses of technology and healthy eating for adolescents.

All of the technology-based interventions examined in this review had at least one positive dietary intake finding. Although the studies by Dixon et al²⁴⁸ and Banos et al²⁴⁰ did not include a direct measure of food intake, participants still thought that the program had positively influenced their eating habits. These findings add to the previous work by Vaitkeviciute et al¹³⁹ and Brooks and Begley,¹⁵² by indicating the potential for technology to assist FL-related programs. It should be noted that dietary intake data were self-reported; therefore, results are subject to respondent bias. Results may also be influenced by social desirability bias (providing answers that one thinks are socially acceptable or similar to what others might think).^{70,71} Baranowski et al²³⁹ and Thompson et al²⁴⁷ did include the use of a “lie” scale²⁵⁷ at baseline to assess participants truthfulness in relationship to their response as a means to reduce the potential of social desirability bias. However, none of the other studies addressed this form of bias.

Several important gaps emerged from this review. First, while there is growing acceptance of the definition of FL, identifying specific FL-related components within existing studies is challenging. None of the studies reviewed included any specific mention of FL; identification of FL components was done by reviewers. Furthermore, to what degree should a program include planning and management, selection, or preparing before it can be considered a FL program? Is it possible for a program to be labeled as a “FL program” with one or two components or must all four elements be included? These are questions that need to be answered so that the largely subjective nature of assessing a nutrition- or food-related program as embodying FL can be made more objective. Studies identified in this review included a range of two to four FL concepts. Aside from the concept of eating, food selection skills were the most popular, with seven interventions

including this construct. Building skills to select food is an important behavioral component of a healthy lifestyle, but it is only one step in the process. It is also difficult to compare results across studies based on the variety of measures and reporting methods used. For example, Banos et al included all FL components; however, dietary intake was not formally measured.²⁴⁰ This makes the impact of the intervention difficult to ascertain in comparison to a program that used only one or two components but measured dietary intake with a 24-hour recall or food frequency questionnaire. Second, currently there are no valid and reliable tools to measure FL in an adolescent population. Only one FL measure has been tested for reliability and validity.²⁵⁸ The online questionnaire was designed for 9 and 10 year-olds in New Zealand and includes 65 questions covering nutrition knowledge, food origins, food knowledge and skills, and demographic information.^{7,259} While this is a step in the right direction, the developmental and cognitive differences of adolescents make the need for a specific FL tool for this unique population extremely important. In addition food-related knowledge is often used as a proxy for FL,⁷ but it is widely understood that knowledge is not the sole indicator of behavior change.^{40,41,260} Furthermore, FL is more than just acquiring knowledge. At its core, FL is about acquiring and developing the food-related skills necessary to help create behavior change. Third, while adolescents may be considered digital natives and all eight studies reviewed here showed that technology can be a positive influence on dietary intake, more research is needed to determine what specific component of technology (e.g. games, virtual meal planning, tracking of dietary intake, social media, etc.) provide the best and most effective influence. Duration of exposure is also important because behavioral interventions of medium to high intensity (26 to 75 plus hours) have been

shown to provide the best results for programs shorter than 12 months.⁸² Specific contact duration for the technology portion of the interventions was not indicated for three studies^{240,246,248} with the remaining indicating a range from six hours to just several minutes. Additionally, only two studies^{238,240} included a control group that did not utilize technology. This, coupled with the variation in technology and lack of consistent exposure, makes it even more difficult to tease out the influence of the technology component on any dietary outcome.

In addition to previously discussed limitations, the scope of this review was highly restrictive and may have reduced the number of studies examined. Strengths of this review include the use of PRISMA and the Downs and Black scoring system. Additionally, a comprehensive search of 13 databases was made and articles were evaluated by two reviewers. This systematic review solidifies previous finding and identifies important gaps to be addressed in order for future researchers to provide meaningful contributions to the field of FL.

4.5 Conclusions

Adolescents are at a point in their developmental growth when food-related skills become the foundation for lifelong healthy eating. Engaging this population in the acquisition of these skills requires innovative methods, including the use of technology. Continued work in defining and measuring FL along with developing fun and appealing ways to plan and manage, select, and prepare foods through the use of technology will be important for these digital natives. However, standardized procedures are needed to define, measure, and evaluate programs through the lens of FL.

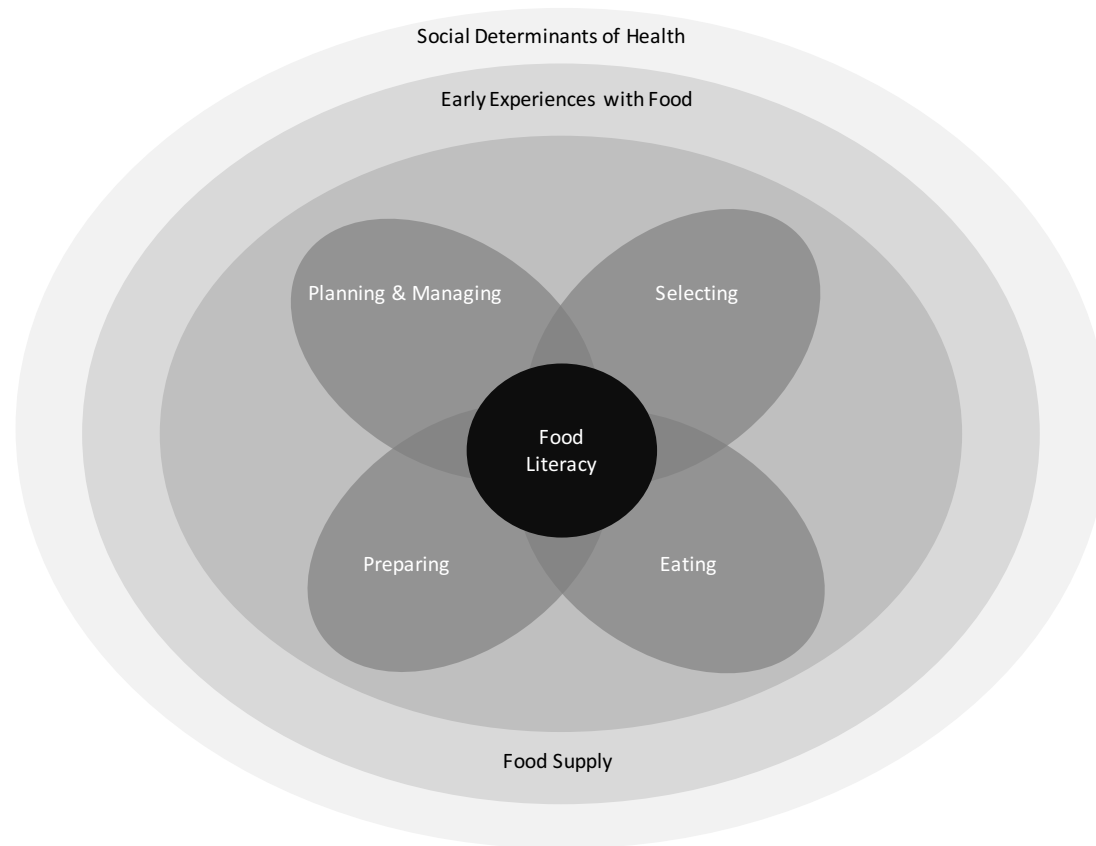


Figure 1.1. Food literacy model.⁷

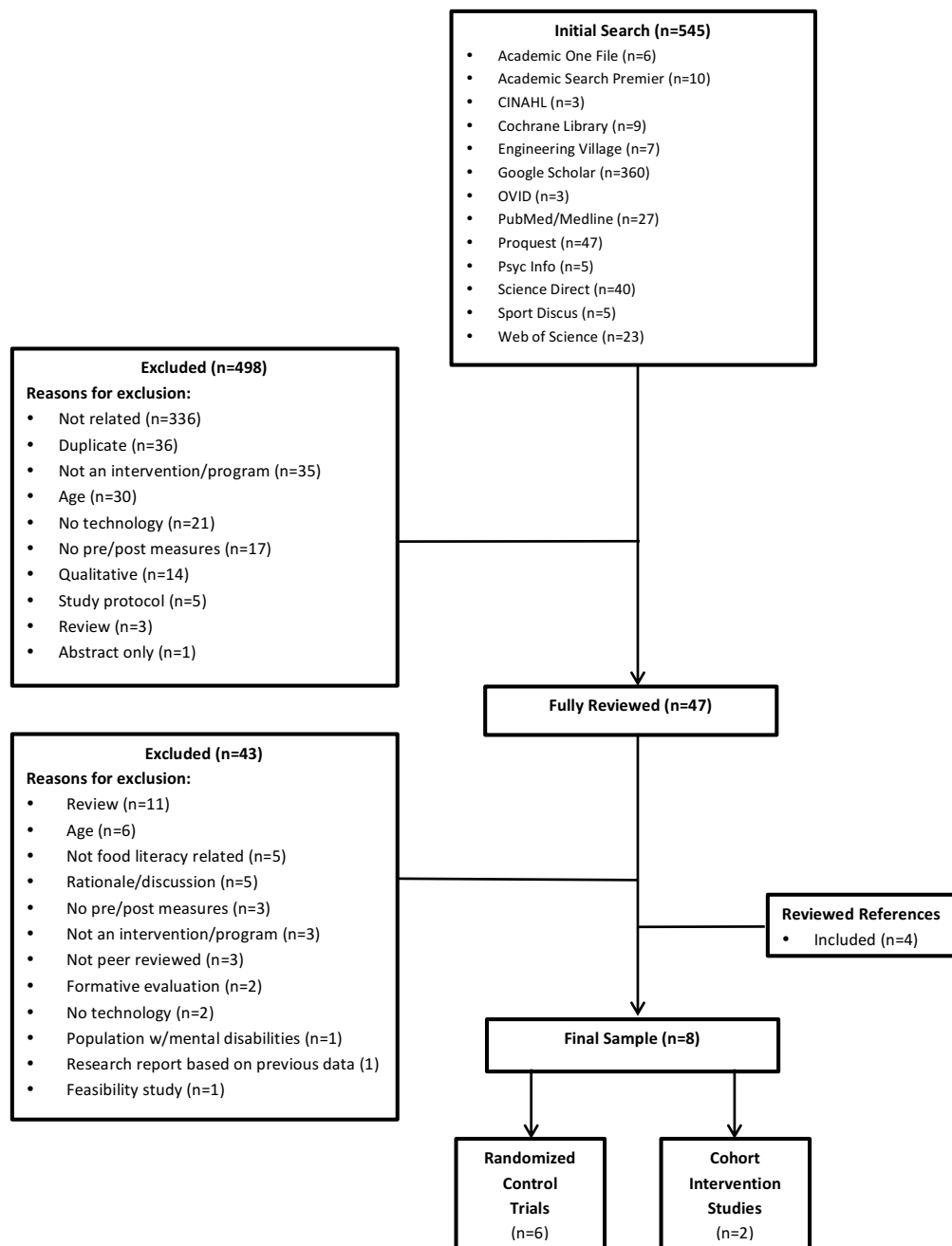


Figure 1.2. Selection process.

Table 1.1. PICO Statement.

Population	Adolescents 12-19 years old (populations younger than 12 years old will be considered if the program also includes participants who are at least 12)
Intervention	Interventions that include FL components (planning and managing, selecting, and/or preparing food) and also include technology as part of the program
Comparison	Pre- and post-test knowledge and dietary behavior assessments
Outcomes	Increased knowledge and improved dietary behaviors

Table 1.2. Randomized control studies, quality score of study design.

Reference	Individual Randomization	Sample Size Calculated	Control Group	Retention $\geq 80\%$	Baseline Group Equivalent	Pre-Post Test Design	Missing Data	Validated Measures	Isolate Technology	Score (% of Maximum)	Rating
Banos et al ²⁴⁰	N	N	Y	UK	Y	Y	N	Y	Y	55.55	+ Intermediate
Baranowski et al ²³⁸	Y	Y	Y	UK	Y	Y	Y	Y	Y	88.88	+ High
Baranowski et al ²³⁹	Y	N	Y	Y	N	Y	Y	Y	N	66.66	+ Intermediate
Long & Stevens ¹⁶⁴	N	Y	Y	UK	Y	Y	N	Y	N	55.55	+ Intermediate
Muzaffar et al ²⁴⁶	N	Y	Y	Y	N	Y	N	Y	N	55.55	+ Intermediate
Thompson et al ²⁴⁷	N	Y	Y	Y	N	Y	Y	Y	N	66.66	+ Intermediate

N, no; UK, unknown; Y, yes

Table Heading	Scoring Criteria
Individual Randomization	Were participants randomly assigned to study conditions? If so, was randomization at the individual level? Stratified and blocked randomization is acceptable. Studies that used individual randomization combined with a small proportion of randomized matched pairs are also considered Y. Appropriately designed and powered group randomization would also be acceptable if group was also unit of analysis. Individual randomization is N when the authors fail to mention randomization, specify that another method of assigning group status was used, or randomize at the group level and analyze at the individual level.
Sample Size Calculation	Was power analysis reported to determine study sample size? If a feasibility or exploratory study for which sample size cannot be calculated beforehand, then N/A.
Control Group Retention	Did the study include a comparison group? Comparison group could be a no treatment, treatment as usual or alternate treatment group. Was study retention at least 80% of subjects who initially agreed to participate in the study? Retention is calculated for the entire sample and not by group. Studies not reporting retention/dropout rates, retention can be calculated using the analysis sample sizes (e.g. 300 randomized but only 250 included in analyses = 83.3% retention).
Baseline Groups Equivalent	Were tests conducted to determine whether groups were equivalent at baseline regarding important variables (e.g. gender, age, weight)? If no tests mentioned, then unknown/unclear. If subset of tests indicated any group differences at baseline, then = N.
Pre-test/Post-test Design	Was assessment of behavior completed pre- and post-intervention?
Missing Data	Were analyses conducted with consideration for missing data that maintain the fidelity of the randomization (e.g. intent to treat, imputation)? Likewise, case deletion (completer analysis) = N if only analysis conducted. If 100% retention, then completer analysis is appropriate = Y. If authors compared the 'dropped subgroup' with the selected or randomized sample but did not consider the impact of the dropped subgroup on randomization (e.g. intent to treat or imputation), then code as N.
Validated Measures	Did the description of measures include reliability and validity information? If reference or coefficients, then Y. If well-established measure known to be validated, then Y. For objective measures without validity evidence, if the objective measure is used as a proxy (e.g. food receipts for nutrition intake), then N. If the objective measure is used as a direct measure of behavior (e.g. food receipts for food purchase), then Y. If validity not reported and measure unknown, then unknown/unclear.
Isolate Technology	To isolate the technology, the authors had to test the technology alone and compare with a group with no technology (Y). Packaged intervention in which the technological components cannot be parsed out are coded as not isolating the technology (N)

Table 1.3 No control intervention studies, quality score of study design.

Reference	Population Source	Sample Size Calculated	No Prior Exposure	Retention $\geq 80\%$	Baseline Equivalent	Pre-Post Test Design	Missing Data	Validated Measures	Isolate Technology	Score (% of Maximum)	Rating
Dixon et al ²⁴⁸	Y	N	Y	UK	N	Y	N	N	N	33.33	- Low
Turnin et al ²⁴⁹	Y	N	Y	N	N	Y	N	N	Y	44.44	+ Intermediate

N, no; UK, unknown; Y, yes

Table Heading	Scoring Criteria
Population Source	Was the source of the study population explained?
Sample Size Calculation	Was power analysis reported to determine study sample size? If a feasibility or exploratory study for which sample size cannot be calculated beforehand, then N/A.
No Prior Exposure	Did the population have prior exposure to the program?
Retention	Was study retention at least 80% of subjects who initially agreed to participate in the study? Retention is calculated for the entire sample and not by group. For studies that did not report retention or dropout rates retention can be calculated by using the sample sizes used for analysis (e.g. 300 randomized but only 250 included in analyses = 83.3% retention).
Baseline Equivalent	Were tests conducted to determine whether participants were equivalent at baseline regarding important variables (e.g. gender, age, weight)? If no tests mentioned, then unknown/unclear. If subset of tests indicated any participant differences at baseline, then = N.
Pre-test/Post-test Design	Was assessment of behavior completed pre- and post-intervention?
Missing Data	Were analyses conducted with consideration for missing data that maintain the fidelity of the randomization (e.g. intent to treat, imputation)? Likewise, case deletion (completer analysis) = N if only analysis conducted. If 100% retention, then completer analysis is appropriate = Y. If authors compared the 'dropped subgroup' with the selected or randomized sample but did not consider the impact of the dropped subgroup on randomization (e.g. intent to treat or imputation), then code as N.
Validated Measures	Did the description of measures include reliability and validity information? If reference or coefficients, then Y. If well-established measure known to be validated, then Y. For objective measures without validity evidence, if the objective measure is used as a proxy (e.g. food receipts for nutrition intake), then N. If the objective measure is used as a direct measure of behavior (e.g. food receipts for food purchase), then Y. If validity not reported and measure unknown, then unknown/unclear.
Isolate Technology	To isolate the technology, the authors had to test the technology alone and test the technology alone and compare with a group with no technology (Y). Packaged intervention in which the technological components cannot be parsed out are coded as not isolating the technology (N)

Table 1.4. Overview of all studies.

Reference	Sample	Research Design/ Duration	Technology /Exposure	Intervention	Control	Nutrition-related Outcomes	Significant Results
Banos et al ²⁴⁰	N=228, aged 10-13 years, 50% female/male, all Caucasian, mean BMIz-score 0.50	Two group RCT, randomized by school, 2 weeks	Website with serious games, instructed to use the program as often as they wanted	Intervention group (<i>ETIOBE Mates</i>) used an educational website including serious games.	Pamphlets	Nutrition knowledge, acceptability including influence on eating habits, and playability of website.	<ul style="list-style-type: none"> Both groups increased nutrition knowledge, intervention group increased significantly ($P=.037$) 30% of intervention participants indicated program changed their eating habits 50% of indicated liked the program
Baranowski et al ²³⁸	N=1578, aged 8-12, 52% female, 44.8% Caucasian	Two group, randomized by school, 5 weeks	Internet-based interactive multimedia game, 10 sessions/~25ea	Intervention group used <i>Squire's Quest!</i> This program follows a story about the kingdom of 5A Lot. Through the story participants complete challenges and work to meet nutrition-related goals.	No program	Consumption of fruit, 100% juice and vegetables	<ul style="list-style-type: none"> Between group difference in favor of the intervention group for fruit ($P=.002$), regular vegetables ($P=.001$), and total fruit, juice and vegetables ($P=.002$) Amounts to a 1.0 serving between group difference in Fruit, juice and vegetables consumption.
Baranowski et al ²³⁹	N=133, aged 10-12 years, 56.2% male, 39.9% Caucasian, mean BMIz-score 0.86	Two group RCT, individual randomization, 9 sessions with 2 month post follow-up	Internet-based games, 40 minutes play per session ~6 hours total	Intervention group used games to practice knowledge and meet goals.	Booklet and DVD with Internet-based games	Consumption of fruit, vegetable, water	<ul style="list-style-type: none"> Significantly greater increase in intervention groups intake of fruit ($P=.001$) and fruit and vegetable ($P=.018$) 80-90% of children reported liking the games
Dixon et al ²⁴⁸	N=53, aged 10-14, 62.26% female	Intervention during a summer camp, no control group, 5 days	Internet-based menu planning plate, exposure time not indicated	Participants attended the <i>Cook Like a Chef</i> camp which featured cooking and menu planning activities. Used Menu Planning Plate website to plan meals.	N/A	Consumption of fruits and vegetables, self-efficacy for planning healthier meals.	<ul style="list-style-type: none"> Decrease in the percentage of participants who indicated planning daily meals would result in eating more fruits (82.35% pre vs. 80.39% post) or vegetables (88.24% pre vs. 72.55% post). Nonsignificant increase in vegetable consumption (belief they would eat) vegetables and fruit. 64.71% were confident in planning meals, 84.31 felt the Menu Planning Plate was easy to use, 52.94% planned to use the recipes and plate at home.

Reference	Sample	Research Design/ Duration	Technology /Exposure	Intervention	Control	Nutrition-related Outcomes	Significant Results
Long and Stevens et al ¹⁶⁴	N=121, aged 12-16 years, 52.1% female, 46.2% Caucasian	Two group RCT, randomized by classroom, 1 month	Internet-based website featuring some game elements, 5 hours	Website and classroom instruction used for nutrition education. Website included three adventure-based modules	Nutrition education embedded in classroom instruction	Consumption of fruits and vegetables, and self-efficacy for fruits and vegetables	<ul style="list-style-type: none"> • Significant between group differences in favor of intervention group for self-efficacy of fruits and vegetables ($P < .01$). • No significant difference in consumption of fruits or vegetables although intervention group had higher posttest scores.
Muzaffar et al ²⁴⁶	N=214, 6 th – 8 th grades, 31% overweight or obese	Two group RCT, randomized by class and individual randomization in afterschool program, 2 weeks	Internet-based active learning website featuring video, narration, and games, exposure time not indicated	Healthy Outcomes for Teens (HOT) program used active online learning site including videos, narrated text and games.	Text-based passive online learning	Meal planning skills, dietary intake	<ul style="list-style-type: none"> • Significant within group improvements in intervention groups meal planning skills ($P < .001$) and dietary intake of fruits and vegetables ($P = .002$) for intervention and control groups • Significant between-group difference ($P < .0001$) in favor of intervention group for meal planning skills with the largest improvements ($P < .001$) for vegetables/fruit
Thompson et al ²⁴⁷	N=473, aged 10-14 years, all male, predominantly Caucasian	Two group, two wave RCT, randomized by Scout Troop, 9 weeks with 6-month follow-up	Internet-based website featuring scout-based comic book characters and included games, ~25 min per session	Boy Scout Five-A-Day Badge program utilized website and in troop instruction focused on consumption of fruits and vegetables	Internet-based website program focused on physical activity	Consumption of fruit, juice, and vegetables, self-efficacy for fruit, juice and low-fat vegetables	<ul style="list-style-type: none"> • Significant within group difference for intervention group's consumption of fruit and juice ($P = .028$) at end end of intervention but not at 6-month follow-up • Significant between group difference ($P = .003$) in favor of intervention for fruit and juice consumption and self-efficacy for low-fat vegetable ($P = .004$) • Significant between group difference ($P = .014$) in favor of control for low-fat vegetable consumption
Turin et al ²⁴⁹	N=580, aged 11.5 – 16.4 years, 11.6% obese	Intervention during school day, no control group, 6 months	Computer kiosk, average session took less than 1 minute	<i>Nutri-Advice</i> kiosk available to students during the school day. Food items mirrored offerings for lunch. Students selected virtual meal and system provided feedback on selections.	N/A	Student's choices of dairy, cheese, starch, fruits and vegetables and deserts, BMIs, and obesity %	<ul style="list-style-type: none"> • Overall significant increase in selection of fruits and vegetables ($P = .05$), dairy products ($P = .03$), and starch ($P = .03$), and significant decrease in selection of cheese ($P = .002$), and desserts ($P < .001$). • Significant decrease in obesity % ($P = .04$) and BMIz ($P < .001$)

CHAPTER 5

***“JUST SAY IT LIKE IT IS!”* USE OF A COMMUNITY-BASED PARTICIPATORY APPROACH TO DEVELOP A TECHNOLOGY-DRIVEN FOOD LITERACY PROGRAM FOR ADOLESCENTS**

5.1 Introduction

One in three adolescents is overweight or obese,²¹ a number that has quadrupled in the last 35 years.¹ Unhealthy dietary practices are contributing factors to this problem and current data indicate that adolescents are not meeting dietary recommendations for 1 ½ - 2 cups fruit and 2-3 cups of vegetables per day. In fact, the median daily intake is just one (1/2 cup) serving of fruit and slightly more than one (1/2 cup) serving of vegetables.³ Consumption of sugar-sweetened beverages is also concerning as adolescents drink more sugary beverages than any other age group.³⁴ Adequate nutrition and physical activity are important to help adolescents achieve optimal growth and maturation.^{9,37,38} Increasing food-related knowledge and skills is needed to counteract the growing obesity trends.^{116,261,262} One way to address this problem is by promoting food literacy (FL).

FL is a relatively new term that derives from the fields of health and health literacy. At its core, FL is the ability to use food knowledge and skills to make healthy dietary choices and encompasses aspects of planning and managing, selecting, preparing, and eating healthy foods.^{7,130-133} The framework is built upon the interdependence of conceptual knowledge, procedural knowledge, and motivation to participate in healthy eating practices.¹³⁴ Conceptual or factual knowledge is the ability to understand simple facts and information about food (e.g., vitamin A is important for my vision). Procedural

knowledge is the ability to put facts into action (e.g., sweet potatoes are high in vitamin A and will help me meet vitamin A recommendations). Motivation to participate refers to influences that can help or hinder an individual's ability to make healthy choices (e.g., I don't know how to cook sweet potatoes). FL programs work to develop food knowledge and skills in an effort to help build a foundation upon which healthy choices can be made.¹³⁴ Adolescence is a unique developmental stage in which the ability to fully understand the consequences of choices and decisions is formed. Therefore, generationally-appropriate FL programs are needed for this population and the use of technology in these programs may help increase the appeal to youth.^{152,263}

Adolescents are digital natives having grown up in a world with computers, the Internet, cellphones, and social media. Nearly 87% have access to a computer, 88% have access to a cellphone and 25% of cellphone users are considered "cell-mostly" meaning the cellphone is their primary access point to the Internet.^{12,235} A recent national survey (N=1156) indicated 84% of adolescents are using the Internet for health information with fitness and exercise and diet and nutrition being the most sought information.²⁶⁴

Cellphone use is also changing the landscape of how adolescents communicate with 91% using their cellphone for text messaging, sending an average of 67 messages each day.¹² Texting is viewed as faster and easier compared to traditional phone calling²⁶⁵ and the ability to text is the top reason for getting a cellphone.²⁶⁶ Adolescents are often early adopters of technology^{235,267} and online and cellphone-based diet and physical activity programs have shown promise in improving healthy behaviors.^{163-166,178,179,263} Technology-driven FL programs, therefore, offer the opportunity to engage adolescents in a medium that is not only familiar but well liked. While dietary trends of adolescents

indicate a need for FL programs and technology may increase their appeal, additional approaches such as community-based participatory research (CBPR) are also needed to engage this population.

CBPR is a collaborative approach that empowers community members to be the decision makers for activities that directly impact their lives and communities.¹⁶⁻¹⁸ CBPR evolved from traditional research methods where participants are viewed as “subjects” upon whom programs are “performed”.¹⁹⁰ The CBPR approach reverses this traditional view by giving voice to the community and engaging them as partners with researchers throughout the research process. While including community members in all phases of the research process (assessment through communication of results) is the gold standard, this approach is not always feasible. In fact, a 2013 review of the use of CBPR with children and adolescents found that out of 56 CBPR studies only 17% included the approach in all phases of research.¹⁷ The use of CBPR is gaining in popularity, but it is not as often used with adolescents as it is with adults.^{190,204} It is possible that the inherent power dynamic between adults and children, or a belief that adolescents cannot understand the intricacies of research, influence the use of the approach.¹⁷ Cognitively adolescents are at a stage in which they are trying new things, taking risks, and developing the capacity to make decisions.⁸ As such, partnering with this aged audience to create and deliver a program not only offers insight into what is important or engaging to them, but also provides an opportunity for them to develop their skills to make good choices and decisions regarding healthy foods.

Current research has begun to explore the use of adolescent FL programs.¹⁵² Research has also examined the role of technology in helping adolescents make healthy

food choices.^{73,163-166,169,170,172-174,178,179} However, no research to our knowledge has been conducted using a CBPR approach to inform the development of a technology-driven FL program for adolescents. Therefore, the objectives of this study were to form an advisory group (Kid Council) to direct the design of a FL program and to implement a pilot version of the program to assess participants' attitudes to participate. Specific aims were to: 1) collect and implement the recommendations of adolescents regarding the development and delivery of the program and 2) explore the potential of technology to influence adolescents' participation.

5.2 Methods

5.2.1 Participants & Recruitment

Participants were recruited from Springfield, MA. This large Western New England city has a diverse population of whom 43% are Latino, 40% are less than 25-years old, and roughly 33% live below the poverty level. Forty-two percent of children in Springfield are overweight or obese, which is higher than the state and national average of 25.2% and 33.6%, respectively.^{21,36,207} Participants were recruited for a Kid Council (KC) and a pilot program. The KC was designed to provide feedback on the program's design and development and included adolescents from the community where the pilot was implemented. Recruitment for both the KC and the pilot program occurred at the Greater Springfield YMCA, North End Outreach Center. To participate, adolescents needed to be between the ages of 11 and 15, have access to a computer and a cellphone, and be able to read and speak English. Parents were required to provide consent and participating adolescents were required to provide assent. Recruitment flyers were placed throughout the North End Outreach Center. To encourage participation in the KC

participants received a \$20 gift card for each session attended. Incentives for the pilot program included a fitness tracker, weekly take home bags packed with a food item, and a \$5 gift card for each session attended. Approval for the project was obtained from the University of Massachusetts Institutional Review Board.

5.2.2 Procedures

A discussion guide was developed to help prompt discussion of key program topics during KC meetings, which included use of text messages, music, incentives, activities, recipes, and administration of surveys. A facilitator began each KC by asking questions from the guide. The first KC gathering included discussions about text messages, music, incentives, and the surveys. The second encompassed conversations related to program activities and included a taste test and discussion of five sample recipes. The KC and pilot program were held at the North End Outreach Center in Springfield, MA. Each KC lasted approximately 1 hour, was audio taped and all materials were collected from participants for review. Input from the KC informed the development of the pilot program.

The pilot program, called *FuelUp&Go!*, included six in-person sessions and was based on a previously developed intervention called *Strength and Power In Nutrition* (SPIN).²⁰⁹ Each meeting included a key topic and related activities. Table 2.1 outlines topics, activities, and related components. The six topics areas were: 1) introduction to making food choices; 2) recognizing and critically analyzing the power of advertising; 3) discovering the benefits of fruits and vegetables through the “circles of protection”; 4) exploring exercise and the importance of water for hydration; 5) investigating the sugar content of sugar-sweetened beverages; and 6) wrap up and review of food choices. In

addition to in-person content, three technology-related components were used throughout the program: UpMove™ fitness tracker and app; weekly text messages; and a companion website. All participants received a fitness tracker and were set up on the associated app. Participants were encouraged to wear the device and sync it to the app to track their steps. Each week a series of text messages were sent to participants to encourage participation in the program, remind them of key activities such as challenges and goals, and to provide food and health-related information. The website included material to support the sessions including exercise tips, recipes, links to sites such as ChooseMyPlate.gov and further explanations of materials. Each pilot session was scheduled for 1 hour and took place from September through November 2015.

5.2.3 Measures

Three questionnaires were developed: 1) a knowledge, attitude, and behavior (KAB) survey, 2) a food consumption survey, and 3) a program evaluation. Participants were asked to complete the KAB and the food consumption survey at the first and last session. The program evaluation was administered at the last gathering. The KAB questionnaire was adapted from the Wisconsin Farm to School Evaluation Knowledge, Attitude, and Behavior Survey and from existing resources such as ChooseMyPlate.gov and the American Heart Association.²¹¹⁻²¹³ The survey comprised a total of 41 questions including nine multiple choice knowledge-related questions, 13 food- and physical activity-related attitude questions (based on a 4-point Likert scale) and 19 behavioral questions (based on a 4 to 5-point Likert scale). The food consumption questionnaire was adapted from the Youth and Adolescent Questionnaire²¹⁰ and included 65 questions related to the consumption of fruits, vegetables, and beverages. This survey also included

four demographic questions. The program evaluation contained a total of 31 questions to determine how they felt about each program component, as well as questions to assess how food items included in take home bags were used. Five open-ended questions were included to gain perspective on what was learned and how this knowledge would be used. All scales were ranked from one to four or five, so that a higher number indicated a more positive response.

5.2.4 Analysis

Audio recordings from KC sessions were transcribed verbatim by a professional transcriptionist. Each transcript was checked by a member of the research team to verify quality and content. Transcripts were coded and analyzed for recurrent themes using QSR International NVivo Version 11.3.2. Qualitative data were structured around main topic areas: text messages, music, incentives, recipes, activities, and health-related knowledge, thoughts, and comments. Data from the pre- and post-surveys were coded and analyzed using Statistics Package for Social Sciences Version 24 (IBM Corp: Armonk, NY). Knowledge-related questions were assigned a value of 1 for correct and 0 for incorrect. Rating scores were calculated for individual attitude and behavior questions and scores for related questions were summed to create overall attitude or behavior scores for fruits and vegetables, sugar-sweetened beverages, and physical activity. Food consumption surveys were reviewed and data transformed to represent servings per day. Differences in pre- and post-survey scores were analyzed using paired t-tests.

5.3 Results

5.3.1 Kid Council – Demographics

Four participants (n=3 males, n=1 female) participated in the two KC sessions held at the end of August 2015. Participants ranged in age from 13 to 16 years old. One self-identified as Latino, two as African American, and one as Caucasian and Native Hawaiian/Pacific Islander.

5.3.2 Kid Council - Food Knowledge and Surveys

Out of a possible nine points on the food and nutrition knowledge portion of the KAB survey, the highest score was three points. Participants engaged in discussion about several KAB questions. For example, participants expressed confusion about the five groups associated with MyPlate and one respondent described the groups as, “definitely not milk, protein, fat, or grains.” This participant also had difficulty understanding the term *dairy* and what constituted a dairy product and asked “Okay 'cause macaroni salad has egg in it, so would that be considered as dairy?” When the facilitator explained that the egg would be part of the protein group, the respondent asked, “So what’s part of dairy?”

When completing the food consumption survey, participants had trouble identifying several food items including okra, eggplant, and collard greens. In addition, there were distinct negative reactions to certain foods such as prune juice, beans, broccoli, and coleslaw. Assumptions about taste were also made based on the name of the food. For instance, one participant said, “Syrup is sweet. It's supposed to be sweet, but it says brown rice, so that must mean it's made out of some type of nasty food and it tastes nasty.” Participants were also quick to point out words that were not understood (e.g.,

grams), but equally quick to provide each other with nutrition-related knowledge. For example, after one participant said "...I love soda it is my life" someone responded, "You should drink water, it helps."

5.3.3 Kid Council - Program Activities

Taken out of the context of the program, KC members had difficulty understanding the activities, such as the activity called *Circles of Protection* in which circles represented different food groups that provide defense and strength/structure for the body. The original activity asked a participant to place check marks in each of the circles based on what he or she ate over the course of the day. Instructions had to be repeated several times and ultimately KC participants felt the activity was not fun, engaging, or motivating. One participant suggested the following:

Like maybe instead of coloring you have to like draw the picture and then like, like, then you have to like draw like we can't draw the same picture twice. So that's kinda fun cause then it's like, it's a challenge.

The group was intrigued by hands-on activities that allowed them to be creative and challenged them to design items themselves such as an advertisement, nutrition label, or even a homemade soda. The desire to be challenged was a common theme. In fact, participants felt that several of the activities were "too easy". Simply writing things down was not perceived as fun; participants wanted more fun and creative ways to record information.

When it was explained that participants in the pilot would be asked to set weekly goals, KC members were concerned that people could misrepresent their achievement of a goal. One member said, "What if people just fill them in to fill them in?" They were also concerned with their own ability to maintain a goal-long term. As one adolescent

stated, “Order a small portion of something like fries or soda. I can try. I would try that but I don’t know how long that would last.”

All KC feedback and comments regarding activities were reviewed by the research team. Hands on demonstrations and experiences such as a measuring activity for grams of sugar were included to increase participant interaction. Directions for the *Circles of Protection* activity was changed from requiring simple check marks to asking participants to draw pictures of what they had eaten over the course of the day. The verbal introduction to weekly goals was edited to emphasize selecting realistic goals that participants felt they could truly accomplish.

5.3.4 Kid Council - Taste Tests and Recipes

KC members were also asked to participate in taste tests of five sample recipes. Council members expressed negative preconceived biases against several food items (hummus and couscous) even if they had never tried them. In fact, participants were unsure of what hummus and couscous were and therefore were cautious about tasting these items. As one participant said, “The hummus, I think that's what I'm tasting. I never really ate hummus like that” and another council member said “Because I've heard of couscous before I just never had it before...That’s good.” A common theme throughout the KC discussions was the need to make sure foods were flavorful. One participant expressed this by saying:

Let me clear it up. It has to have seasoning, a whole bunch of seasoning. Like, I can't eat those string beans without no potatoes in it, and then they have to season it... If broccoli had like, flavor, like- I know it's not gonna taste like chicken, but if it had a little seasoning, I would probably like it. Like corn, corn on the cob, if you have that and put some salt and stuff on it...

Participants were asked to rate each of five recipes they tasted on a 10-point hedonic scale (1 = frowning face, and 10 = smiling face). The Bites of the Round Table (tortilla pinwheel with hummus and vegetables) scored the lowest with a mean score of 6.0 points. The Toe Stompin' Trail mix (a blend of cereals and dried fruits) scored the highest with a mean of 8.5 points. The mean rating of the Cool Cool Couscous was 7.75 points despite receiving two 10 point and one 9.0-point rating. The additional items, Confetti Veggie Burrito (vegetable and bean burrito) and Kooky Cheese Fruit Kabobs (cheese and fruit kabobs) received mean ratings of 8.0 and 7.75 points, respectively.

Recipes were reviewed and modified based on feedback to emphasize flavor. For example, additional salsa was added to the Confetti Veggie Burrito, the Cool Cool Couscous was cooked with low-sodium vegetable broth instead of water, and a garlic hummus was used in the Bites of the Round Table. In addition, a greater focus was placed on discussing the components of the recipes throughout the program. An example of this was explaining what hummus is, incorporating a fun fact about chickpeas and hummus, providing additional recipes for chickpeas and hummus, and including a can of chickpeas in take home bags.

5.3.5 Kid Council - Technology and Text Messages

All participants indicated they had a cellphone, could access the Internet from their phone, and used their phones for text messaging. When asked what they liked about text messaging responses included “Because it's fast. I don't have to call you. I don't have to say what I have to say. I can text it out” and “It's like calling doesn't even exist anymore, really.”

Regarding the type of text messages preferred for a program intervention, participants wanted them to be direct. For example, “What you eating today?” vs. “You have the strength and power to make choices about the foods you eat. What choice will you make today?” In addition, they wanted messages to be simple, fun and include the use of emojis. Fun facts such as “Go bananas today! It’s banana lover’s day they’re so a-peeling”, where appealing and thought to be funny especially if a banana emoji was used in place of the word banana. Participants disliked the inclusion of numbers in messages such as explaining that 2000 steps equals approximately one mile. One participant illustrated this by saying:

And they're probably thinking- 'cause I'm gonna think how people who don't exercise think, 'cause I already know, that's a lot of damn walking... 2000 steps per 1 mile. I'm not doing that... How far did you walk today? Um ... Don't ask how far it was. Ask, did you have a nice walk today or, like, something like that, cause [sic] it seems like that's a lot of steps you've got to take, and I'm not about to take that many steps. And I don't like walking, so I'm like, ugh... That's calculating like, oh, 2000 steps....

Although emojis were well liked, participants did not like the use of abbreviations. When asked if “U” should be used in place of “you” one participant responded “No, I'd spell out you. I hate people who text like that. I think they're kind of slow when they do that.” When asked if the use of abbreviations for phrases such as LOL for *Laugh Out Loud* should be used, several supported the use of abbreviations for common phrases; however, one participant felt that abbreviations are not always understood “...’cause like, someone told me B-R-B... And I was like, what?”

Participants also expressed a preference for the use of certain terms such as *exercise* vs. *physical activity* and *sugar-added* vs. *sugar-sweetened* beverages. This preference arose out of a desire to be direct and not hide behind more complicated words.

As one participant stated, “just say it like it is.” Based on this feedback all activities and documents were reviewed. *Physical activity* was replaced with *exercise* and all references to *sugar-sweetened* were replaced with *sugar-added*. In addition, abbreviations were not used; however, emojis were used in place of words when possible.

Messages were grouped into one of two categories: informational and directive or response-based. Informational messages provided information regarding topics including exercise, water, and fruits and vegetables. These messages were also directive and asked participants to do something such as sync their tracker to log their steps. Response-based messages asked participants to send back a reply, often in the form of an emoji. For example, a message might read “Text back a water emoji if you feel you could substitute water for a sugar-added beverage.” Table 2.2 shows text messages before and after participant feedback.

5.3.6 Kid Council – Music and Incentives

Participants liked a variety of music including classic rock, country, gospel, and hip hop. Music was viewed as a positive factor with gospel music being a motivator to do better and hip hop, in particular, making participants want to move and have fun. Some surprising emotions were discussed regarding music. For instance, one participant noted that “I kind of- I used to like country music, I don't know why. I used to like country music 'cause they was always in their feelings, and I just was like, I understand. I feel how you feel...”

Participants were also asked what would encourage them to participate in the program. One option was to earn points that could be used to buy small incentives such as Frisbees or water bottles. Another option was to earn points and the person with the

highest number of points would receive a large prize (e.g. bike). Overwhelmingly, participants wanted everyone to be able to get something. One participant explained it this way: “Because people get mad about that. They'd be like, oh, I'm depending on this, and then- yeah. Then they'd - then somebody else got to and they'd be mad and fight. No fighting.”

When the facilitator explained that teens would also receive a gift card for each session they attended KC members agreed that the cards would help motivate people to participate and recommended a variety of stores including Walmart, Target, iTunes, and GameStop. When asked if gift cards from a local thrift store would be useful, one council member stated “That would be so embarrassing to get a gift card for [that store]. That's so embarrassing” others agreed.

Based on the feedback from KC members motivating songs were selected to engage participants in exercise sessions during the pilot program. While numerous song recommendations were made most were not suitable for inclusion due to inappropriate language or themes. KC participant’s suggestions to include gift cards from Walmart and Target as well as specialty cards such as iTunes, Google Play and GameStop were planned for the pilot. The program was also designed so that points could be accumulated for participating in activities. For example, for attending each session participants earned 25 points. The points were collected over the course of the intervention and small prizes including water bottles, jump ropes, puzzles, sunglasses, etc. could be purchased with the points on the last day of the program.

5.3.7 Pilot Program – Demographics

A total of 21 adolescents were recruited to participate in the pilot study, of these only 13 provided consent forms and nine completed pre- and post-intervention surveys. Participants ranged in age from 11 to 16 years old; two-thirds (n=6) were female. All participants indicated they had access to some form of mobile technology (cellphone or tablet); however, not all participants were permitted by their parents to carry a cellphone or tablet with them throughout the day.

5.3.8 Pilot Program – Knowledge, Attitude, and Behavior Survey

Pre- to post-survey results are shown in Table 2.3. Knowledge remained low (3.56 out of a possible 9.0-points) at post-survey; however, the pre- to post-trend in knowledge was positive. Overall, average attitudes toward fruits were high at both pre- and post-survey (11.67 and 11.11 points, respectively, out of a possible 12 points.) Attitudes toward vegetables were moderate at baseline (9.44) and increased slightly at follow-up to 9.89 points, out of a possible 12 points. Attitudes toward sugar-added beverages increased over the course of the program which reflects an increased liking of sugar-sweetened beverages. Post-intervention physical activity attitude scores increased .23 points to 11.67 out of a possible 12 points. Behavior questions related to fruits, water/sugar-added beverages, and physical activity increased in a positive direction from pre- to post-survey; however vegetable behavior scores decreased slightly from 25.11 to 23.56 points out of a total of 40 points.

5.3.9 Pilot Program – Food Consumption Survey

The food consumption survey was administered after the KAB at both baseline and follow-up. Observations from the research team indicated participants experienced

test fatigue and had difficulty staying focused to complete the questionnaire. One post survey was not filled out completely and four pre- and two post-surveys showed that participants checked all the boxes in one row down the entire page. Overall data from the food consumption surveys showed that participants (n=4) decreased their consumption of fruits, vegetables, and water, and increased their consumption of sugar-added beverages.

5.3.10 Pilot Program – Evaluation of Program Components

All program components were rated on a five-point scale (1 = least liked, 5 = most liked). Technology components were fairly well received, with the website receiving the highest rating of 4.38 points and wearing the tracker receiving the lowest rating (3.13 points). All in-person elements were well received. Weekly tips provided at the start of each session were the most liked feature (4.5 points), followed by advertising and sugar-sweetened beverages topics (4.38 points each). Using the FuelUp Goal Card (a goal setting instrument designed to have participants self-select weekly goals), taste tastings, and take home bag received a rating of 3.75 points each. At each session participants received a weekly challenge such as walking 10,000 steps each day, analyzing food advertisements for attention getters, or showing a family member or friend how to read a food label. Participating in the weekly challenge received the lowest rating of 3.0 points (sort of liked). Table 2.4 provides an overview of participants' ratings.

5.3.11 Pilot Program - Healthy Messages

At the last session, participants were asked to write a message to other adolescents explaining what they learned. Figure 2.1 shows several examples of these messages, which ranged from simple statements such as “They are wonderful love veggies” or “Eat

you [sic] veggies and fruits every day,” to more reflective messages “Be more aware of the amount of grams of sugar in sugar added beverages. Be sure to drink water often and replace most of these sugar added beverages.”

5.4 Discussion

Overall, pilot program participants responded positively to the program including its use of technology. All KC and pilot members were recruited from a population base identified as lower income and all had access to a cellphone or some form of mobile technology as well as the Internet. These findings are consistent with other findings indicating that lower-income populations are using cellphones as a means to connect to the Internet.¹² Despite having access to technology and cellphones, not all those participating in the pilot program carried the devices with them or were allowed to use the technology throughout the day. This behavior was due in part to parental controls and presented obstacles to syncing and recording fitness tracker information.

KC members were eager and excited to provide feedback on text messages. Their preference for simple direct phrases is in keeping with previous research by Woolford et al¹⁸⁷ showing that adolescents want messages that tell them what to do. Text messages that provided fun facts were also well liked and again this observation is supported by previous research.¹⁸⁴ KC members identified messages that would be motivating and fun for peers their age and provided suggestions for terminology and language. While these suggestions were used to strengthen the messages and engage other adolescents to participate in the pilot, the use of text messages by pilot members rated only 3.5 points out of 5.0 indicating only a moderate liking of these components. Before the next phase

of the program is launched, information from the KC and pilot will need to be reviewed to increase engagement with this important part of the overall program.

Emojis were well liked and KC participants wanted them to be included as much as possible, this is a finding supported by trend data and previous research.^{12,268} As a result of the increase in popularity of visual communication, health-specific versions have been suggested (e.g., diabetes emojis).^{269,270} While research in this area is limited, emojis have been integrated into communication channels from college campuses to The White House.²⁶⁹ The use of pictures can help younger-aged participants and those with lower health literacy understand health-related information.²⁷¹ Because emojis are pictures, they have the potential to relay information without the use of words and their use helps provide visual cues that may be lacking in the digital vs. face to face form of communication.^{272,273} Visual Analogue Scales or face pain scales have been used in healthcare as a means of identifying how one is feeling without the use of text or words. Though they may be most often used with children they have been identified as a valid assessment method with older populations^{274,275} as well as adolescents.²⁷⁶ These scales have also been used to determine likability of food products in marketing or nutrition-related research. A 2013 study that tested pre-literacy aged children's ability to identify healthy and unhealthy foods found that they could correctly identify these foods with the use of emojis.²⁷⁷ Comparisons can also be made with the use of infographics which are visual depictions of key information. For instance, a study by Arcia and colleagues²⁷⁸ found that use of context-specific infographics in healthcare settings helped people understand their own health-related data.

The KC provided valuable information to help refine the *FuelUp&Go!* program. Music selections, incentives, recipes, and program activities were all modified where possible based upon their feedback. This strengthened the program and helped provide focus on factors that would increase motivation to participate. While CBPR may not be used as often with adolescents, it is an important approach in developing programming, as adolescents know best what other peers their age may want and like. Including adolescents in delivering program elements is also important. A CBPR informed study by Bogart et al²⁰² showed positive dietary changes in schools with peer advocates. Additional research has also indicated that adolescent peers strongly influence eating behaviors.³⁸ Had time and resources allowed, involving KC members as peer-to-peer advocates may have helped strengthen attitudes toward program elements.

Participants in both the KC and the pilot had low food-related knowledge; however, pilot program participants' food knowledge increased from 3.00 to 3.56 points after completing *FuelUp&Go!* Small positive changes were also observed in vegetable and physical activity attitudes; and fruit, water/sugar-added beverages, and physical activity behaviors of pilot participants. Of note, although attitudes toward sugar-sweetened beverages reflected a negative change, behaviors toward drinking water instead of sugar-added beverages was significantly reduced at follow-up ($P<.04$). While food-related knowledge does not always translate to better dietary behaviors, prior research has shown an association between higher food knowledge and better dietary practices.^{42-44,49} The question remains as to the type of knowledge (i.e. factual, procedural or both) that may be most effective in leading to healthy changes. Therefore, more research is needed to determine which type of knowledge (i.e. factual, procedural or both)

may be most effective in initiating healthy changes. *FuelUp&Go!* provided opportunities to gain factual knowledge but also helped increase capacity to put this knowledge into action. This outcome was accomplished through the inclusion of hands-on activities, demonstrations, discussions, and weekly challenges designed to allow participants to apply what was learned to real-life situations. In fact, the messages pilot participants wrote explaining what they learned showed an understanding of not only factual knowledge (e.g., *eat your veggies and fruit* and *beware of grams of sugar in sugar-added beverages*) but procedural knowledge (e.g., *eat your veggies and fruit every day* and *drink water to replace sugar-added beverages*). These messages are telling because they reflect the impact of the program in the participants' own words.

Pilot participants responded favorably to technology components; however, few recorded physical activity on their trackers. In fact, minimal data were recorded from just four participants and all others indicated that they forgot to wear or had lost their tracker. While KC members were enthusiastic about text messages, only three pilot program participants actually responded to a text message and attitudes towards text messaging were moderate. Although the messages were changed based on KC feedback, KC members were not asked if they preferred a different method of receiving this type of content. A study by Schiano et al²⁷⁹ indicated adolescents have different preferences for communicating with peers (texting) and adults (email).²⁸⁰ Since the messages were sent by the research team (consisting of adults) it is possible that this factor influenced participation. Another obstacle may have been the cost of texting. However, no questions were asked regarding data or texting plans and compensation was not provided to cover the cost of the text messages.

Limitations of this study include the small sample size of both the KC and the pilot program and the limited number of KC sessions held. Recruitment took longer than anticipated and researchers were advised by community members that previous programs experienced difficulty in recruiting adolescents. Furthermore, there was inconsistent attendance at pilot program sessions. Due to schedules and conflicts, participants did not attend all sessions. Also, changes to program components including recipes, activities, and incentives were made based on the available facilities (e.g., no equipment to heat food), the size of the room and group, available time, and ability to obtain gift cards and incentives in required dollar increments. In addition, participants experienced test fatigue at both baseline and follow-up, which may have impacted the reliability of the findings. As a result, revisions to several of the surveys are planned before future programming begins. Finally, qualitative findings can only provide an idea of the motivation of individuals and cannot be generalized to other populations.

5.5 Conclusions and Implications

Adolescents are testing and developing decision-making skills, they have a desire to try new things, and they are reward-motivated.⁸ Because CBPR is a unique collaborative process that gives voice to those involved, provides participants the opportunity to make decisions, and rewards participants with the power to make a lasting change, it can be an ideal research approach to use with this population. The use of CBPR was helpful in developing *FuelUp&Go!* and effective in creating a program influenced by the needs and wants of a representative sample of adolescents. The implication is that adolescents can improve their food-related knowledge and skills from a technology-

driven FL program. Future research involving this program will examine the potential to effect meaningful change in food and physical activity-related attitudes and behaviors.

Table 2.1. Outline of *FuelUp&Go!* program topics, activities, and related components.

Session	Activities	Music	Food Clue/Take Home Food	Taste Test Recipe	Exercise	Challenge
#1: I Got the Power!	<ol style="list-style-type: none"> 1. Introduce program 2. Discuss what affects the choices we make about foods and beverages we eat and drink 3. Setup trackers and Compete surveys 	<i>The Power</i> by Snap	<p>In the ground I am a root and Bugs will pick me just to chew. I'm often orange but it has been said I come in purple, yellow, white and red. When it comes to health, EYE can see the benefits of picking me. What am I?</p> <p>Carrots</p>	Totally Cool Cool Couscous	Grab Bag - Circuits	Find two advertisements related to food.
#2: Advertising	<ol style="list-style-type: none"> 1. Identify powers of the mind and body 2. List places where marketers get their attention 3. Identify strategies that marketers use to compete for their powers 4. Explore how senses can be impacted by marketing 	<i>Let's Get it Started</i> by Black Eyed Peas	<p>I'm not an apple or a pear but I have a tropical flare. I'm spiny outside but sweet and juicy, one taste and you can't refuse me. Say aloha to this week's fruit eat it fresh, frozen, canned or juiced! What am I?</p> <p>Pineapple</p>	Kooky-Cheese Fruity Kabobs	Circuit stations	Design an advertisement for a fruit or vegetable
#3: Circles of Protection	<ol style="list-style-type: none"> 1. Discover and discuss the four circles of protection 2. Identify sources of product information and recognize how the information relates to the circles of protection 3. Compare and contrast various food labels 4. Discuss the costs and benefits of various food products 	<i>Eye of the Tiger</i> By Survivor	<p>I'm not a chicken or a pea instead I'm a legume you see. Roast me, mash me, mix me in, spread me on a pita thin. I'm full of protein and fiber too and just for fun I have a name or two. This week we'll try a bite, and you'll get to take some home tonight. What vegetable am I?</p> <p>Chickpeas</p>	Bites of the Round Table	Balloon Challenge	Personalize the circle of protection by recording the foods eaten over the course of the week.

#4: Exercise and Water	<ol style="list-style-type: none"> 1. Technology and Goal Check-in 2. Discuss components of physical fitness 3. Discuss the role of water in keeping our bodies hydrated 	<i>Jump</i> by Van Halen	<p>I'm not a raisin or a grape but you can use me in their place. I float on water when I'm whole and I'm often eaten when it's cold. To check if I'm good inside bounce me and I will rise. Jellied, dried, fresh and juice why not take a taste or two?</p> <p>Cranberry</p>	Toe Stompin' Trail Mix	Circuit exercises and take pulse	Try and do 10,000 steps each day
#5: Sizing Up Sugar-Added Beverages	<ol style="list-style-type: none"> 1. Explore the secrets of sugar-added beverages 2. Identify the amount of sugar in popular sugar-added beverages 3. Make homemade soda 4. Analyze sugar-added beverage labels 	<i>We will Rock You</i> by Queen	<p>I'm red and juicy and full of taste you'll see me in soup, sauce, and even paste. I 'mato know which type to pick but you can slice me thin or thick. Slice me, dice me, chop me up, throw me in a salsa cup. You know me as a vegetable, but I'll fool you 'cause I'm a really a fruit, either way I'm good to boot! What am I?</p> <p>Diced Tomatoes</p>	Chop Chop Salsa	Stretches	Size up a sugar-added beverage and use knowledge of food labels to analyze sugar content
#6: The Power of Choices and Decisions Wrap-Up	<ol style="list-style-type: none"> 1. Discuss how we make food choices and how we can use our new product investigator powers to make healthy decisions 2. Complete post-intervention surveys 	<i>Never Would Have Made It</i> by Marvin Sapp	<p>Oh my darling this week's fruit is sort of tiny and kind of cute. If you peel me and look inside my sections are the perfect size. I'm juicy, sweet and tasty too why not have one or two. What am I?</p> <p>Clementine</p>	Clementine	Ball Toss	N/A

Table 2.2. Sample text messages before and after kid council input.

Original Text Message	Changes based on Kid Council Input
Your goal is to eat at least 5 veggies and fruits a day. That's about 2.5 cups. Have half a cup at breakfast, 1 cup at lunch, and 1 cup at dinner	<p>Informational and Directive Messages</p> <p>Fruits and veggies come in a 🌈 of colors. Challenge yourself to try a new veggie today!!</p>
Try replacing 1 soda a day with water. You have the strength and power to make choices about the foods you eat. What choice will you make today?	<p>Sync your tracker to your 📱 and check out your 🏃</p> <p>Your Up app misses you 😊! Don't forget to log your fruits, veggies and beverages and sync to your band to log your steps. You can do it!</p> <p>Thirsty?? 💧 can help power you up!!</p> <p>Did you have a fruit or veggie today?? Don't forget to log it in the app</p>
Your Go Card misses you! Why not check in and check off at least one box? 60 minutes of physical activity a day may seem like a lot so try braking it up into 15 minute intervals.	<p>Don't forget your Go Goals!</p> <p>✓off your list today and earn 5 points.</p> <p>Make all those 🏃 count. Sync your tracker with the Up app now!!</p>
On a scale of 0 to 10, how hard will it be for you to drink water instead of a sweetened beverage today? (0=very easy, 10=very hard) 16 grapes = 1 serving so why not grab a bunch!	<p>Response-Based Messages</p> <p>Think you can switch one sugar-added beverage for 💧 today?? Text back 💧 if you think you can!</p> <p>Fruit is naturally sweet and a great snack. Try and switch one sugar added snack with a fruit. Text back your favorite fruit emoji if you're up for the challenge</p>
It can be a challenge to do your session challenge but the rewards are worth it!	How many 🏃 have you taken today? Challenge yourself to do more steps than you did yesterday. Text back if you're up for the challenge.
Use your PI powers to determine the amount of sugar in the next can of soda you think you want to buy (hint 4 grams = 1 tsp). No do you still want to buy it?	Feeling thirsty? Remember 💧 is really the best way to hydrate. Text back your favorite water emoji if you're on board for water.
Power up with dark green and dark orange veggies!	It's picture day so say...fruits and veggies!! Snap and send a picture of a meal that includes fruits and veggies 📷
2,000 steps = 1 mile! How far did you walk today?	How many 🏃 in a mile?? About 2000. Set a goal for yourself today and let the miles add up. Text back your goal.

Table 2.3 Pre- and post-intervention knowledge, attitude, and behaviors scores of pilot program participants (n=9).

	Pre-Survey Mean (SD) ^a	Post-Survey Mean (SD)	Paired t-test <i>P</i> -value
Knowledge Score	3.00 (1.32)	3.56 (1.59)	.42
Attitude Scores			
Fruits	11.67 (0.71)	11.11 (1.45)	.18
Vegetables	9.44 (2.50)	9.89 (1.69)	.65
Water	10.78 (1.92)	10.78 (1.64)	-
Sugar-Added Beverages	2.75 (1.17)	3.00 (1.13)	.73
Physical Activity	11.44 (1.67)	11.67 (1.00)	.35
Behavior Scores			
Eat Fruit	27.67 (3.87)	31.56 (8.29)	.12
Eat Vegetables	25.11 (5.97)	23.56 (7.80)	.33
Drink Water Instead of Sugar-Added Beverages	3.78 (0.44)	4.56 (0.73)	.04*
Physical Activity Days per Week	6.22 (2.28)	6.56 (2.13)	.68
Physical Activity Minutes per Day	2.78 (0.83)	2.89 (0.78)	.68

^aSD = standard deviation**P*<.05

Table 2.4 Participants' attitudes toward program components (n=9).

	Mean Rating ^a
Technology Components	
Website	4.38
Syncing Tracker	4.00
Texting	3.50
Wearing Tracker	3.13
Program Components	
Weekly Food/Health Tips	4.50
Take Home Bags	3.75
FuelUp Goal Card	3.75
Food Tastings/Recipes	3.75
Weekly Food Clue	3.63
Weekly Challenge	3.00
Weekly Topics	
Advertising	4.38
Sugar-Added Beverages	4.38
Circles of Protection	4.00
Water and Exercise	4.00

^aRating Scale: 1 = didn't like at all, 5 = really liked a lot

Fruit and Vegetable Message

Always be sure
to have atleast
2-3 cups of vesibles a day,
also have atleast a cup
of fresh fruits!

Fruit and Vegetable Message

they are wonderful
love
vege's
🍌🍌

Sugar Added Beverage Message

Drinks less
juice/energy
less
more water!

Sugar Added Beverage Message

Be more aware
of the amount of
grams of sugar in sugar
added beverages. Be sure
to drink water often
and replace most of
these sugar added beverages.

Physical Activity Message

Play more
outside/less
love phone
lan & physical
activity

Physical Activity Message

60 min. a day
= one day of
physical activity

Figure 2.1. Sample of participants messages regarding what they learned in the pilot program.

CHAPTER 6

FUELUP&GO! A TECHNOLOGY-DRIVEN FOOD LITERACY PROGRAM TO CHANGE ADOLESCENTS' KNOWLEDGE, ATTITUDES, AND BEHAVIORS TOWARD FRUITS, VEGETABLES, SUGAR-SWEETENED BEVERAGES AND PHYSICAL ACTIVITY.

6.1 Introduction

Good nutrition and adequate physical activity are critical factors for optimal growth and maturation in adolescents.^{9,37} However, adolescents are consuming too few fruits and vegetables, too many sugar-sweetened beverages (SSB), and participating in too little physical activity (PA).²⁻⁴ Consequently, one-third of adolescents are overweight or obese²¹ and many will follow a trajectory toward overweight and obesity in adulthood.^{23,24} Social determinants including socioeconomic status and neighborhood environments have been identified as contributing influences to the obesity epidemic.³⁹ However, far less is known about the role that food knowledge and food-related skills play in shaping healthy eating behaviors, particularly for adolescents who are still developing foundational decision-making skills.^{8,152}

Food literacy (FL) is a relatively new concept that reconfigures how the intricate relationship between food-related knowledge and dietary behaviors is conceptualized and operationalized. While the concept includes factors related to social determinants, at its core are the knowledge and skills necessary to create healthy dietary behaviors.^{7,133} These core components include aspects of planning and managing, selecting, preparing, and eating healthy foods^{7,133} and reflect a range of practical skills needed to positively affect changes in food choices.^{137,139} This focus on the practical application of knowledge is

needed as the meal patterns of adolescents are changing.^{151,221} Calories consumed away from home have increased and fast food is the second largest contributor to calories eaten outside the home (9.5%) after store bought foods (11.4%).²²² In addition, shifts in the educational curriculum of schools have moved away from traditional home economic courses resulting in fewer opportunities to gain much needed practical food-related skills.^{227,228} These changes have contributed to the overweight and obesity problem and programs that employ generationally and developmentally appropriate approaches such as the use of technology are needed.^{152,281}

Ninety-two percent of adolescents access the Internet daily.¹² This connection to the Internet is largely driven by the use of cellphones. In fact, almost 88% of adolescents have a cellphone.¹² Social media and text messaging are common methods for communication among adolescents with 76% and 91% using these mediums, respectively.¹² Yet, few FL programs have tapped into technology to deliver or enhance program components. A recent systematic review of adolescent FL programs revealed only one program that utilized technology¹⁵²; thus indicating a gap in the literature.

Against this backdrop *FuelUp&Go!* a technology-driven FL program was developed. The aims of this study were to: 1) examine the changes in adolescents' pre- and post-intervention food-related knowledge, attitudes, and behavior for fruits and vegetables, SSB, and PA; 2) investigate the associations between knowledge and attitudes, and behaviors for each variable; and 3) assess participants' attitudes toward technology and program components.

FuelUp&Go! is based on a previously designed and tested obesity prevention program called *Strength and Power In Nutrition (SPIN)*.²⁰⁹ SPIN was designed to help

participants make healthy dietary and PA choices. The content of SPIN was originally conceived to be delivered in-person. *FuelUp&Go!* expanded on this delivery method with the use of technology including: 1) an app and wearable fitness tracker to monitor PA; 2) weekly informational and motivational text messages; and 3) a companion website for participants, which provided resources and tips based on content covered at educational sessions. The program employed several constructs from Bandura's Social Cognitive Theory including outcome expectations (OE) and self-efficacy (SE).⁶⁶ OE are pertains to a person's perceived likelihood of an event occurring if they act (e.g., eating a healthy diet will improve health). SE is the confidence a person has that he/she can perform an action⁶⁶ (e.g., replace a SSB with water or select fruit instead of a sugary snack).

6.2 Methods

6.2.1 Study Design and Participants

FuelUp&Go! took place in winter and spring, 2016. Two community-based organizations, which serve low-income adolescents in Springfield, MA, were recruited through community contacts. The program covered six food-related topics incorporating all four domains of FL. For example, the program included information regarding planning, selecting, preparing and eating fruits, vegetables and SSBs. The program was delivered at in-person sessions. Each gathering included a recipe and taste test, hands-on activities, discussions, and PA. Participants also received a take home bag packed with a food item related to the sessions taste test, sample recipes, fun food facts, and a \$5.00 store gift card. In addition, points for attending and participating in activities were earned and used to purchase special prizes such as Frisbees and water bottles. Cellphone numbers and service provider information were collected from participants. Each

participant was shown how to set up their fitness tracker, download the app, and asked to sync the tracker to the app throughout the program. Informational/motivation or response-based (required a response) text messages were sent to participants each day via email using appropriate carrier code. Participants were encouraged to visit the website and several informational text messages were linked to content embedded on the site. Inclusion in the study was limited to participants who were between 11 and 18 years-old, lived in Springfield, MA, and had a cellphone. Participation in the research portion of the program required a signed consent from parents/guardians as well as an assent form from each adolescent. Prior approval to conduct this research was obtained from the Institutional Review Board at the University of Massachusetts Amherst. Approval to recruit and conduct the research was obtained from each community partner.

6.2.2 Measures

This community-based intervention used pre- and post-survey assessments. Baseline and follow-up assessments were administered at the first and last meeting. Surveys were used to collect information about food-related knowledge and attitudes and dietary behaviors. The knowledge and attitude survey was adapted from sources compiled by the Network for a Healthy California.²¹⁴ Ten knowledge-related questions included multiple-choice options and 20 attitude questions were based on a 4- or 5-point Likert-scale. A self-reported behavior questionnaire was adapted from the Youth Risk Behavior Surveillance System (YRBSS) survey.^{36,282} The questionnaire included two fruit, four vegetable, two SSB, and four PA questions and included demographic questions regarding age, gender, and race/ethnicity. PA data were gathered via the tracker's app and responses to text messages were collected via email. A final program

evaluation was also administered at the last session to assess participants' attitudes toward program components including technology. Questions were based on a 5-point Likert-scale.

6.2.3 Analysis

Data were analyzed using Statistics Package for Social Sciences version 24 (IBM Corp: Armonk, NY). Knowledge questions were reviewed, coded, and assigned a value of "1" for correct and "0" for incorrect responses. Individual questions were summed to create an overall knowledge score. Attitude (OE and SE) questions were scored and grouped into an overall indicator for each summary variable. Behavior-related questions were coded following the YRBSS survey analysis procedure as described by Eaton et al., to determine the total daily intake frequency for each variable in terms of times/day (a proxy for servings).²⁸³ Changes over time, pre to post, in knowledge, attitudes, and behaviors were analyzed separately by gender and assessed with Wilcoxon's Signed Rank Test. Effect size estimates were calculated using Cohen's *d* standard measure of effect size (.8=large, .5=moderate, .2=small) and were used in comparisons of groups. The interrelationship among knowledge, attitude and behaviors were estimated using the Spearman's Correlation Coefficient. Descriptive statistics including frequencies, means and ranges were calculated for data from the fitness trackers, emails, and program evaluation surveys.

6.3 Results

6.3.1 Demographics

Seventy-six adolescents were recruited, 30 provided consent/assent, and 21 ranging in age from 13-18 (mean age 15 years-old) completed pre- and post-assessments.

Fifty-seven percent (n=12) were female; 76% (n=16) self-identified as Hispanic, 29% (n=6) Black, 24% (n=5) Other, 14% (n=3) White, and 5% (n=1) American Indian or Alaska Native.

6.3.2 Knowledge and Attitudes

Overall food-related knowledge increased significantly ($P < .006$) (Table 3.1). Girls had lower pre and post knowledge scores than boys although both groups had significant changes (girls $P < .06$ and boys $P < .04$). Statistically significant beneficial changes were also found in participants' OE SSB scores ($P < .004$). Beneficial but not statistically significant increases were found in OE PA, SE fruits and vegetables, and SE PA scores. When analyzed separately by gender, boys showed a significant increase in SE for fruits and vegetables ($P < .04$), while girls had a significant decrease in this score ($P < .03$). Boys also had a significant positive increase in OE for SSB ($P < .02$). Lower mean pre and post OE fruit and vegetable and SSB scores were found among girls, while boys had lower mean pre and post OE PA scores.

6.3.3 Behaviors

Consumption of fruits and vegetables increased significantly ($P < .01$ and $P < .001$, respectively) for all participants (Table 3.1). SSB increased from baseline to follow up, while PA remained constant. Girls increased fruits and significantly increased vegetables ($P < .01$) eaten, while boys significantly increased their consumption of fruits ($P < .03$) and vegetables ($P < .03$). Though not statistically significant girls also slightly decreased and boys increased SSB consumed and PA increased slightly for girls and decreased slightly for boys.

6.3.4 Association Between Knowledge, Attitudes, and Behaviors

No associations were found for overall knowledge and OE or behavior scores; however, SE for PA was associated with knowledge for boys ($P < .04$) (Table 3.2). Changes in OE scores were associated with changes in fruit and vegetable behaviors, overall ($P < .01$), as well as by gender (girls $P < .05$ and boys $P < .03$). An association was also found for combined SE for fruits and vegetables and fruit and vegetable consumption ($P < .05$).

6.3.5 Technology and Program Components

Participants liked wearing the fitness tracker (average rating of 4.05 out of 5.00 points); however, syncing the tracker with the app was somewhat less favorable (3.55 points) (Table 3.3). Only 71% of the participants synced their trackers and recorded steps (mean 8,538, range 201-31,042 steps/day). The length of time that the trackers were used varied from 4-74 days. Other technology components such as visiting the website and receiving text messages scored somewhat lower (2.60 and 2.35 points out of 5.00 points, respectively). A total of 68 text messages were sent; 38 were informational/motivational and 30 were response-based. Twenty messages received responses, 25 positive and 12 negative. Most participants (95%) said they liked or really liked the topics related to advertising and SSB (average 4.57 and 4.40 points out of 5.00 points, respectively).

6.4 Discussion

The program significantly increased food-related knowledge and was modestly successful in creating positive changes in OE and SE, as well as self-reported behaviors. These findings are similar to a FL study that found significant increases in knowledge ($P = .02$) and SE for eating fruits ($P < .001$) and vegetables ($P < .009$).¹⁴⁵ Upon further

examination of behavior trends, several important changes were observed. At baseline, participants' reported eating the equivalent of 1.3 servings/day of fruits and 1.7 servings/day of vegetables, which is slightly greater than the 2013 nationally reported data of 1.0 and 1.3 servings/day, respectively.³ Post-intervention, fruit and vegetable intake increased significantly and represents an additional serving of fruit and two additional servings of vegetables/day. For girls, the average number of servings of fruits/day increased from 1.2 to nearly two. Vegetable consumption increased significantly ($P < .01$) from an average of 1.3 servings/day to approximately three servings and represents a moderate effect size of .53. Boys showed even more positive results, with fruit increasing significantly ($P < .03$) from 1.43 to 3.14 servings/day. Boys also increased the vegetables they ate from over 2 servings to slightly more than 4.5 servings/day, both of which indicate a moderate effect size over .50. While these increases still fall short of the recommend servings of fruits and vegetables,²⁶ they do represent positive changes.

While no significant associations were found between knowledge and OE, SE, or self-reported behaviors for fruits and vegetables or SSB, our findings are consistent with previous research.^{41,55,79} Associations were found for dietary behaviors scores and fruit and vegetable OE. Girls and boys decreased their OE scores for fruits and vegetables, which may reflect a negative perception of the perceived benefits of a healthy diet. OEs were not categorized as positive or negative; however, it is possible that participants viewed the questions in a negative manner in essence as an undesirable outcome, one that would take away from more appealing activities.²⁸⁴ For example, choosing fruits and vegetables may mean there is less money to shop for clothes or go to the movies. In our

study a trend toward association was also found between SE and consumption of SSB for boys. Specifically, higher SE is a potential factor in determining higher beverage consumption. Similar to the findings for OE, SE may be influenced by outside factors such as price and availability and therefore may benefit from changes in environmental factors such as easier access to healthy foods.²⁸⁴

The increase in SSB consumption was surprising and differs from several previous studies that showed post-intervention decreases in consumption.^{80,145,166} Although participants were interested in learning about sugar and ranked the session favorably, the information was presented at a time when the Flint, Michigan water crisis was becoming known to the general public.²⁸⁵ Participants expressed concerns for drinking water. In addition, the cost of beverage options may have played a role in choosing between SSB and water. Several participants described the reality of making a decision to purchase a large soda bottle for less than the cost of a smaller water bottle. Although *FuelUp&Go!* was intended to build an individual's decision making skills, these comments show the complexity of making food choices and the necessity for larger scale programs to help address socioeconomic and environmental issues.²⁸⁶

While only minimal data were collected from the fitness tracker, the average steps/day was 8,538, similar to findings from the 2005-2006 National Health and Nutrition Examination Survey, of 6,700 to 8,800 steps/day.^{287,288} How this number translates to the recommended 60 minutes of PA/day is difficult to determine; however, a 2013 study by Adams and colleagues²⁸⁸ indicated 9,000 steps/day may be a standard for studies using pedometers. Regarding texts, although adolescents overwhelmingly use this medium, much of this communication is peer-to-peer with an increasing reliance on free

messaging apps.^{12,289} Messaging apps transmit data over Internet connections and do not require texting plans. Participants were not asked how they like to receive messages and it is possible the texts were seen as an intrusion. In fact, one participant said he thought he would like the texts; however, after receiving them he felt as though they were “in his space.” This finding is supported by other studies indicating teens prefer to communicate with friends via texts but use email for adults.^{279,280} Despite this, texting has been identified as a potentially useful method to deliver targeted and tailored behavioral messages that provide cues to action, reinforcement, and social support for adolescents.²⁹⁰ Continued research in this area is indicated and messages that are targeted and tailored to participants^{184,187} and include peer-to-peer mentors to communicate messages may be best practices.

Use of technology in the program faced several challenges, which resulted in the collection of a small amount of data. First, while participants had cellphones, many did not have cellular data or traditional text messaging packages. This impediment limited their ability to sync the fitness tracker and send/receive text messages. Second, many lost, misplaced, or did not continuously wear their trackers, resulting in partial data collected from only 15 of the 21 participants. Finally, few visited the website despite continued encouragement to do so. While *FuelUp&Go!* experienced several challenges, other programs have successfully used technology to deliver educational information and collect data from adolescents.^{166,179,291,292} Continued research into the use of technology for FL programs is needed and would benefit from the development of best practices including selection of appropriate age groups, limiting number of technology

components, allowing time for participants to become comfortable with technology and incentivizing based on committed and regular participation.

6.5 Implications for Research and Practice

Adolescents are not meeting current dietary and PA recommendations and innovative programs are needed to change these trends. *FuelUp&Go!* a technology-driven FL program yielded some knowledge, attitudinal, and dietary changes. While the program experienced several challenges to incorporating technology, the achievement of beneficial results for nutrition knowledge and self-reported dietary intake offers guidance for future researchers. The use of technology is clearly a medium and space that is comfortable for adolescents; however, the question remains as to how they will use technology for food-related information and improving dietary behaviors. Although more research is needed, the use of a technology-driven FL programs does offer the opportunity to connect adolescents with important foundational food-related skills. Just as literacy can open the book to endless possibilities, FL has the potential to help adolescents cook up better health.

Table 3.1. Pre- to Post-Intervention Changes in Knowledge, Attitudes, and Behaviors.

	n	Pre Mean (SD) ^a	Post Mean (SD)	Z-score ^b	P-value	Effect Size ^c
Knowledge Scores	21	4.43 (1.33)	5.71 (1.23)	-2.73	.006*	-.42
Girls	12	4.33 (1.30)	5.33 (1.37)	-1.87	.06*	-.38
Boys	9	4.56 (1.42)	6.22 (0.83)	-2.03	.04*	-.48
Outcome Expectations Scores						
Fruits and Vegetables	21	37.67 (7.83)	36.52 (9.89)	-.08	.94	.01
Girls	12	36.33 (9.11)	34.75 (12.68)	-.31	.76	.06
Boys	9	39.44 (5.75)	38.89 (3.55)	-.78	.44	.18
Sugar-Sweetened Beverages	20	37.30 (7.94)	41.95 (4.59)	-2.88	.004*	-.46
Girls	11	36.09 (9.72)	40.91 (5.17)	-1.62	.11	-.35
Boys	9	38.78 (5.21)	43.22 (3.67)	-2.32	.02*	-.55
Physical Activity	20	41.55 (12.57)	44.35 (8.29)	-.76	.45	-.12
Girls	11	42.09 (12.51)	46.55 (8.47)	-.83	.41	-.18
Boys	9	40.89 (13.37)	41.67 (7.68)	-.12	.91	-.03
Self-Efficacy Scores						
Fruits and Vegetables	15	36.20 (8.07)	37.07 (6.57)	.00	1.00	-
Girls	8	39.13 (5.38)	35.63 (6.59)	-2.20	.03*	.55
Boys	7	32.86 (9.69)	38.71 (6.65)	-2.03	.04*	-.54
Sugar-Sweetened Beverages	15	24.40 (5.51)	26.00 (3.67)	-1.08	.28	-.20
Girls	8	25.38 (4.84)	27.00 (4.84)	-1.05	.29	-.26
Boys	7	23.29 (6.40)	24.86 (4.56)	-.74	.46	-.20
Physical Activity	16	31.63 (6.86)	33.25 (7.14)	-.41	.68	-.07
Girls	9	29.67 (8.40)	32.78 (8.67)	-.77	.44	-.18
Boys	7	34.14 (3.24)	33.86 (5.15)	-.41	.68	.11
Behavior Scores						
Fruits	21	1.31 (0.98)	2.48 (1.97)	-2.54	.01*	-.39
Girls	12	1.23 (0.93)	1.99 (1.61)	-1.61	.11	-.33
Boys	9	1.43 (1.08)	3.14 (2.30)	-2.18	.03*	-.51
Vegetables	21	1.66 (1.84)	3.60 (1.57)	-3.37	.001*	-.52
Girls	12	1.30 (1.29)	2.86 (0.91)	-2.59	.01*	-.53
Boys	9	2.15 (2.40)	4.59 (1.76)	-2.19	.03*	-.50
Fruit and Vegetables	21	2.98 (2.41)	6.08 (2.92)	-3.51	.0001*	-.54
Girls	12	2.53 (1.77)	4.85 (2.15)	-2.49	.01	-.51
Boys	9	3.58 (3.09)	7.73 (3.10)	-2.43	.02	-.57
Sugar-Sweetened Beverages	21	0.87 (1.14)	1.04 (1.11)	-.81	.42	-.12
Girls	12	1.10 (1.26)	1.04 (1.13)	-.41	.68	.08
Boys	9	0.57 (0.93)	1.03 (1.15)	-1.16	.25	-.27
Physical Activity	21	3.90 (1.97)	3.90 (1.95)	-.35	.72	-.05
Girls	12	3.67 (1.92)	3.75 (1.96)	-.21	.83	-.04
Boys	9	4.22 (2.11)	4.11 (2.03)	-.28	.78	.07

^aSD=standard deviation^bZ-score=post-pre^cEffect Size=Z-score/ $\sqrt{2 \times n}$

*P<.05

Table 3.2. Association between changes in variables for outcome expectation, self-efficacy, knowledge and behavior scores.

	Knowledge Score		Behavior Score ^a	
	Correlation	P-value	Correlation	P-value
Outcome Expectations Scores				
Fruits and Vegetables	-.11	.63	-.72	.01*
Girls	.17	.59	-.57	.05*
Boys	-.49	.19	-.73	.03*
Sugar-Sweetened Beverages	-.02	.93	-.11	.64
Girls	.05	.90	-.01	.99
Boys	-.17	.67	-.26	.51
Physical Activity	-.14	.54	-.14	.55
Girls	-.13	.69	-.34	.31
Boys	-.09	.83	.19	.62
Self-Efficacy Scores				
Fruits and Vegetables	-.10	.71	.52	.05*
Girls	-.32	.44	.61	.11
Boys	-.38	.41	.20	.68
Sugar-Sweetened Beverages	-.24	.39	-.38	.16
Girls	.13	.77	.03	.95
Boys	-.52	.23	-.73	.06
Physical Activity	.27	.31	.87	.75
Girls	.09	.82	-.16	.68
Boys	.77	.04*	.67	.10
Behavior Scores				
Fruits and Vegetables	.32	.89	-	-
Girls	-.18	.58	-	-
Boys	.22	.57	-	-
Sugar-Sweetened Beverages	.20	.38	-	-
Girls	-.20	.54	-	-
Boys	.50	.17	-	-
Physical Activity	.13	.59	-	-
Girls	-.16	.62	-	-
Boys	.37	.33	-	-

^aBehavior Score= Behavior score for related variable (e.g. Fruits and Vegetables, Sugar-Sweetened Beverages, and Physical Activity)

* $P < .05$

Table 3.3. Attitudes toward program components.

	n	Overall Score Mean (SD)^a
Technology		
Wearing Tracker	20	4.05 (1.50)
Syncing Tracker	20	3.55 (1.64)
Visiting Website	20	2.60 (1.85)
Receiving Text Messages	20	2.35 (1.76)
Topics		
Advertising	19	4.47 (0.61)
Sugar-Sweetened Beverages	19	4.42 (0.61)
Water and Exercise	20	4.35 (0.59)
Reading a Label	20	4.35 (0.67)
Activities		
Take Home Bag	20	4.55 (0.51)
Food Clues	20	4.45 (0.69)
Taste Tests	20	4.40 (0.60)
Weekly Tip	20	4.25 (0.79)
Weekly Goal	20	3.65 (1.42)
Weekly Challenge	19	3.53 (1.74)

^aSD=standard deviation

CHAPTER 7

CONCLUSIONS AND IMPLICATIONS

Food Literacy (FL) is an innovative way to examine the relationship between food and dietary outcomes. The concept works to connect people with food not simply at a nutrient level, but at a level in which meaningful food-related skills are developed. However, the role that FL plays in creating behavioral change has yet to be fully explored.

This study had three main objectives: 1) to examine the literature to determine what technology-driven FL studies exist and if these studies positively influenced dietary outcomes; 2) to use community-based participatory research (CBPR) to develop a technology-driven FL program, and 3) to implement and evaluate a technology-driven FL program. Over the course of the study, each of these objectives was achieved and will help move the literature forward in this field.

Few adolescent FL studies exist and far fewer exist exploring the role that technology plays in influencing this important population. The systematic review conducted for this research found only eight studies that employed technology to deliver a portion of an intervention and none of the studies used FL as a basis for designing the intervention. While all of the studies had some type of positive dietary outcome many factors limit the findings. These limitations include a lack of consistency in FL domains included within each study, no validated and reliable FL measures available for adolescent population, and differing technology components used within each intervention. The findings from the review support previous research but also identify specific gaps that helped inform the next phase of this research.

The second part of this study examined the role of CBPR to help inform the design and development of a technology-driven FL program. The approach provided insightful input, on topics ranging from text messages to program recipes. Preliminary data from a small pilot test of the program showed that adolescents improved their food-related knowledge and skills and showed positive attitudes towards the technology components. However, the question remained if meaningful dietary and physical activity changes would result from the program. To examine this outcome, the program was fully implemented with a group of adolescents.

The final phase of this study examined the ability of a technology-driven FL program to positively influence the knowledge, attitudes, and dietary behaviors of adolescents. Findings indicated that the program led to significant changes in food-related knowledge, attitudes towards fruits and vegetables and sugar-sweetened beverages, and positive changes in behaviors towards fruits and vegetables. These are important findings that move the field of FL research forward. In fact, there are currently no other technology-driven FL studies for adolescents known to the author thus making this study the first of its kind.

While this research has begun to lay the ground work future studies should address the challenges experienced regarding technology including the use of fitness trackers, text messages, and websites with adolescents. In addition, the lack of a validated and reliable FL measure for adolescents makes it difficult to assess changes in food-related knowledge and skills over the course of an intervention. Additional research in this field will benefit greatly from the development of a valid and reliable measure. Finally, future interventions involving *FuelUp&Go!* should include a control group. This

will help strengthen the design of the study and provide a benchmark against which study outcomes can be measured.

APPENDIX A

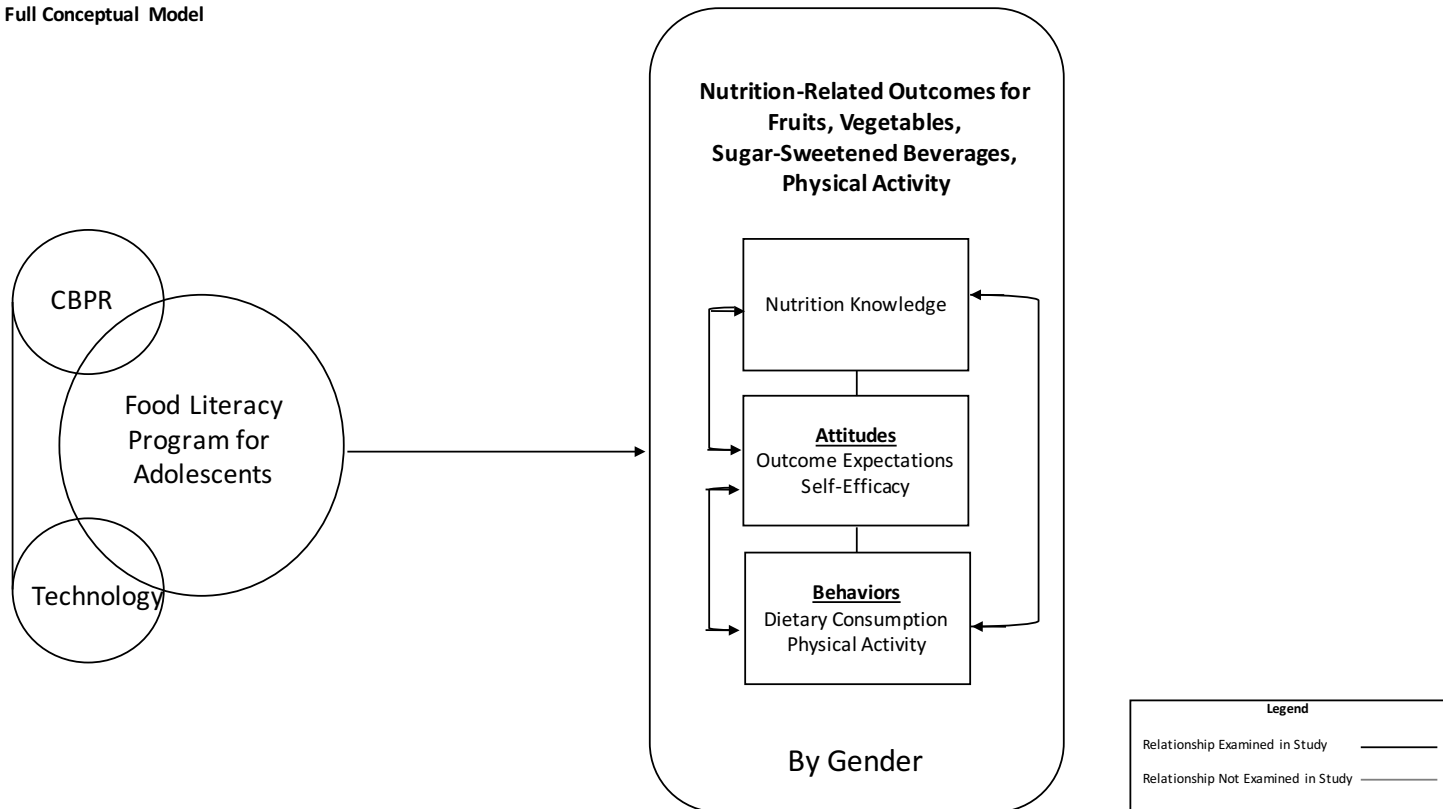
COMPARISON OF SCIENTIFIC METHOD AND COMMUNITY BASED PARTICIPATORY APPROACH

Scientific Method	CBPR^{17,18,194}
Develop Research Question	Form a partnership and create a committee or council with community members and stakeholders to discuss issues to determine a key area(s) of need
Background Research	Along with community members assess the key area(s) of need and develop plan of action
Develop a Hypothesis	With the collaboration of all partners the plan of action is developed into actionable products which are then implemented
Conduct an Experiment	
Analyze Data	Community members and researchers collaborate on analysis of any data from program
Communicate Results	Disseminate and communicate findings and results to local community, stakeholders, and others as deemed appropriate by partners.

APPENDIX B

FULL CONCEPTUAL MODEL

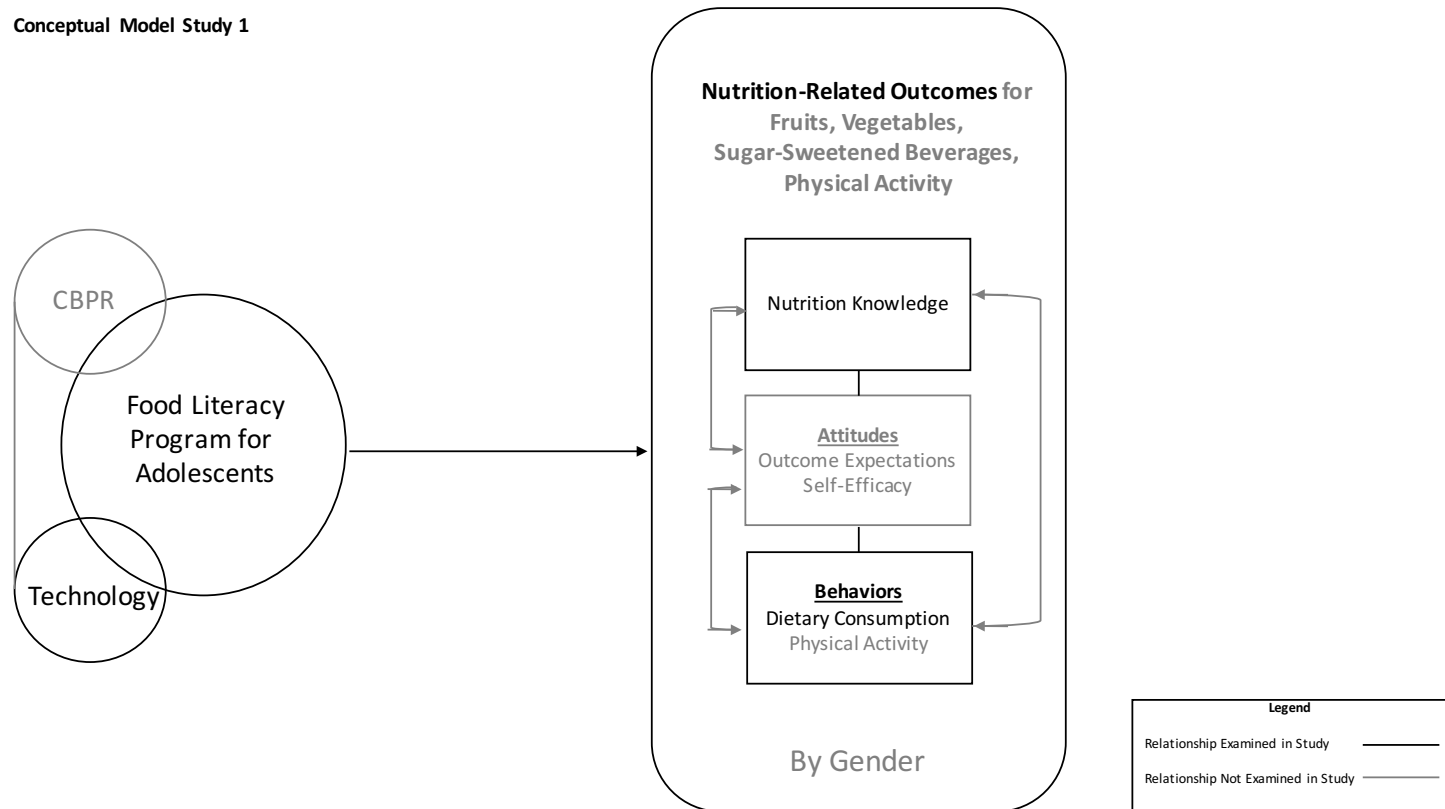
Full Conceptual Model



APPENDIX C

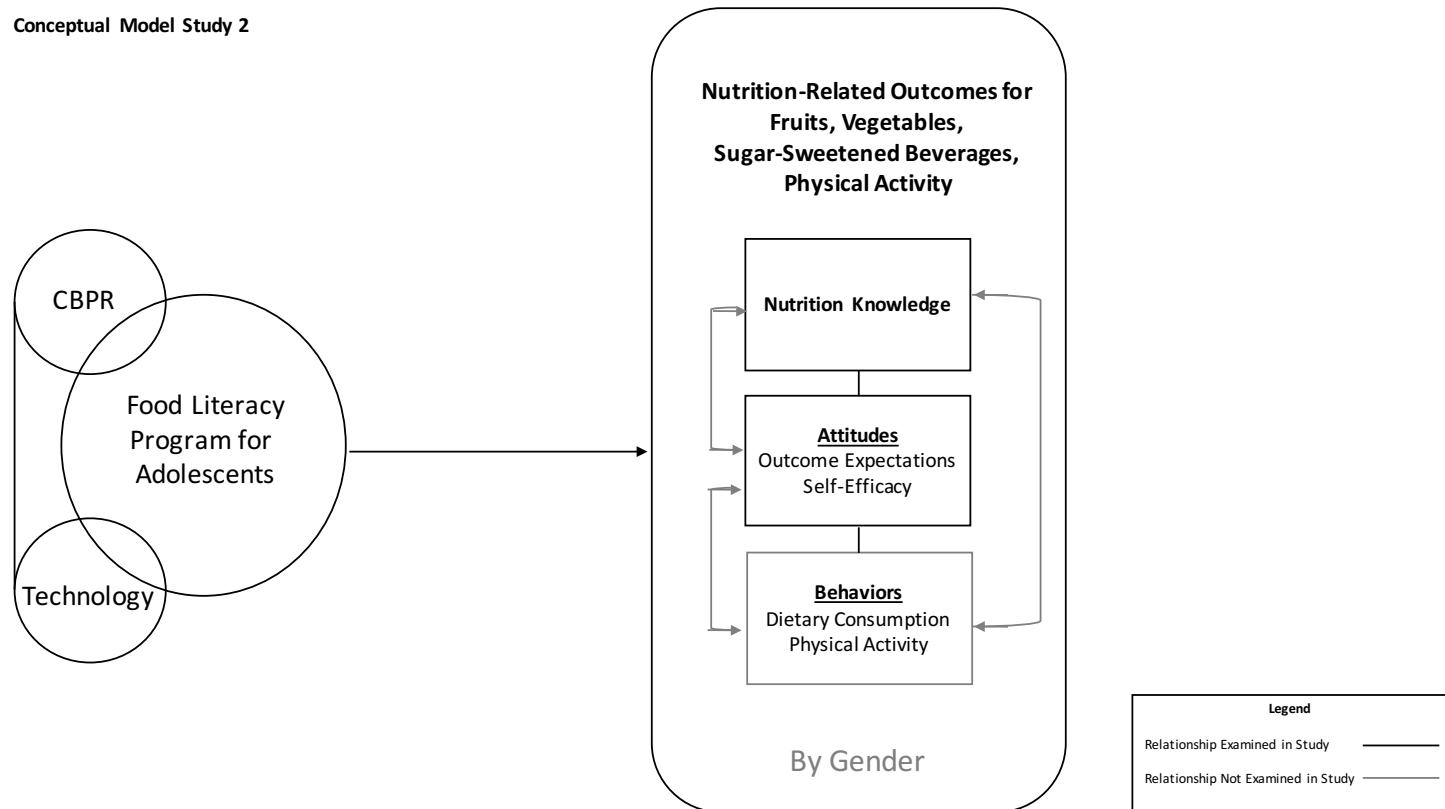
CONCEPTUAL MODEL – STUDY 1

Conceptual Model Study 1



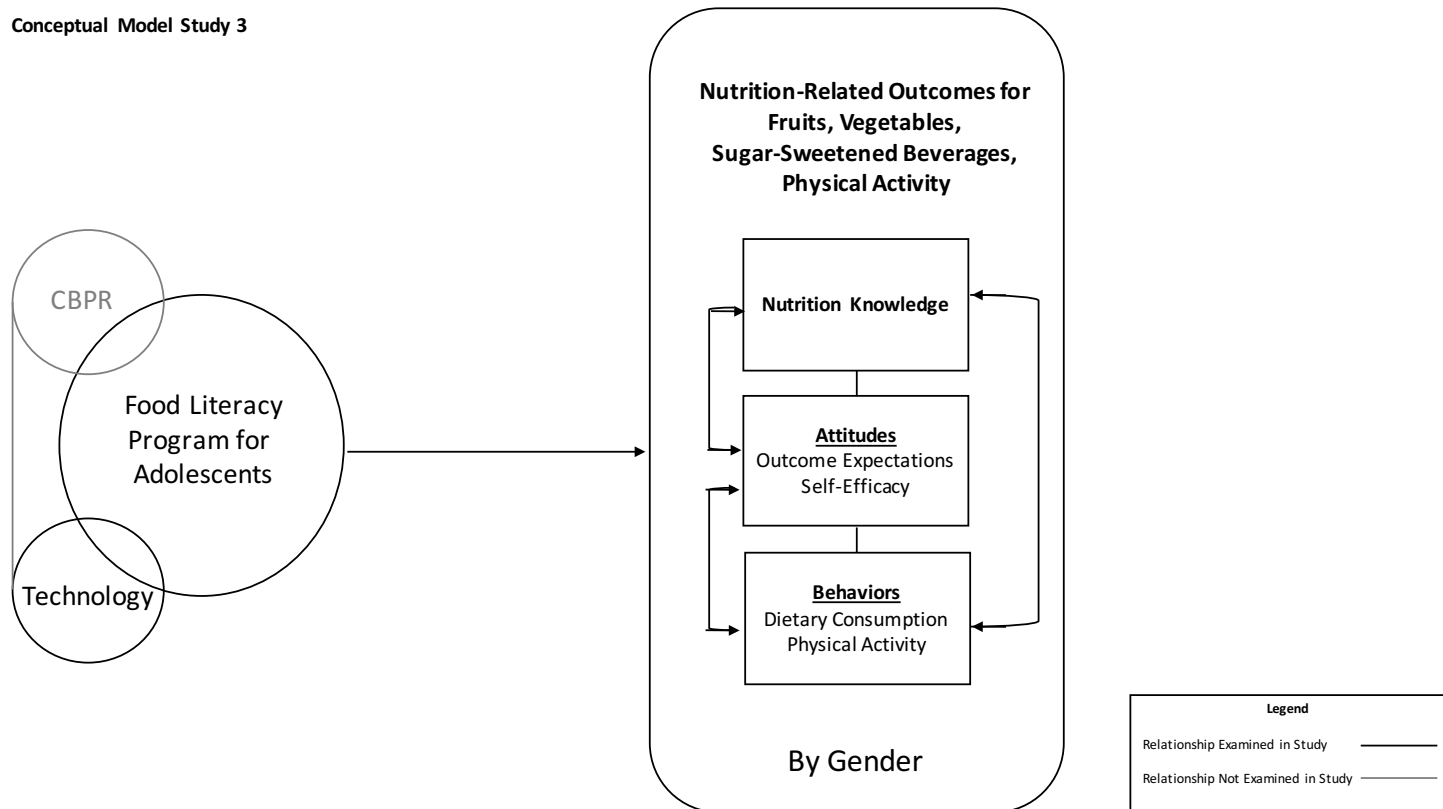
APPENDIX D
CONCEPTUAL MODEL – STUDY 2

Conceptual Model Study 2



APPENDIX E
CONCEPTUAL MODEL – STUDY 3

Conceptual Model Study 3



APPENDIX F

SOCIAL COGNITIVE THEORY CONSTRUCTS

Categories	Construct	Definition
Psychological Determinants of Behavior	Reciprocal Determinism	Environmental factors, influence individuals and groups, but individuals and groups can also influence their environment and regulate behavior
	Outcome Expectations	Beliefs about the likelihood and value of the consequences of behavioral choices
	Self-Efficacy	Beliefs about personal ability to perform behaviors that bring desired outcomes
	Collective Efficacy	Beliefs about the ability of a group to perform concerted actions that bring desired outcomes
Observational Learning	Observational Learning	Learning to perform new behaviors by exposure to interpersonal or media displays of them, particularly through peer modeling
Environmental Determinants of Behavior	Incentive Motivation	The use and misuse of rewards and punishments to modify behaviors
	Facilitation	Providing tools, resources, or environmental changes that make new behaviors easier to perform
Self-Regulation	Self-Regulation	Controlling oneself through self-monitoring, goal-setting, feedback, self-reward, self-instructions, and enlistment of social support
Moral Disengagement	Moral Disengagement	Ways of thinking about harmful behaviors and the people who are harmed that make infliction of suffering acceptable by disengaging self-regulatory moral standards

Social Cognitive Theory Constructs. Adapted from *Health Behavior and Health Education: Theory, Research, and Practice* (page 171), K. Glanz, B.K. Rimer, K. Viswanath, eds., Jossey-Bass, San Francisco, CA. Copyright (2008) by John Wiley & Sons, Inc.

APPENDIX G

RECRUITMENT FLYER

Join *FuelUp&Go!*

WHAT: You have the **strength** and **power** to make choices about the foods and beverages you eat and drink and the physical activity you do. ***FuelUp&Go!*** will help you learn about the **choices** you have and how they affect your strength and power.

WHO: If you're 11 - 15 years old, have access to a computer and a smartphone, read and speak English you're eligible to participate. **You must also receive permission from your parent/guardian to participate.**

HOW: You'll take part in a **fun**, interactive program which includes many activities. You may be asked to do some or all of the following:

- Use **app** to track the foods and beverages you eat
- Wear a **fitness tracker** to track your physical activity
- Visit a **website**
- Receive weekly **text-messages**
- Participate in in-person **workshops**

At the beginning and end of the program you will also be asked to fill out a survey about the fruits and vegetables you eat and the beverages you drink as well a short survey on your nutrition and physical activity knowledge, attitudes and behaviors.

WHAT YOU GET: Throughout the program you can **earn points**. The points can be turned in for **fun gifts** like water bottles, jump ropes, Frisbees, and more! You will also receive a **free Up Move fitness tracker** and will earn a \$5.00 **gift card** for each in-person workshop you attend.

WHERE/WHEN: Participating in the program will take about one hour each week for six weeks and the program will begin in fall 2015.

BENEFITS: You may learn new skills that will help you build your strength and power to make choices about the foods and beverages you eat and the amount of physical activity you do.

CONTACT: If you're interested in being part of *FuelUp&Go!*, please contact Cathy Wickham by email at: cwickham@schoolph.umass.edu (scan the QR code on the left to send a quick message) or call/text 860-460-1678.



APPENDIX H

SAMPLE SCRIPT

FuelUp&Go! Session 2

Be a Product Investigator

- Music**
- iPhone/iPad
 - Let's Get it Started** – Black Eyed Peas – for exercise
- Supplies for Session 2:**
- Pencils
 - Sign In sheet
 - Assent Forms – have a few for new participants
 - UpMove – wearable technology – few for new participants
 - YAQ Surveys /KAP Surveys – have a few for new participants
 - Exercise Cards
 - Gift Cards
 - Sign Out Sheet
 - Go Point recording sheet – hang in front (fill out from week 1)
 - An item of clothing (e.g., t-shirt and/or sneakers/running shoes) with a logo
 - A backpack with a logo
 - A soft drink container
 - A movie character folder or notebook
 - Other items with logos or promotional info – magnets, book covers, logos on printed materials (e.g., posters).
 - Computer
 - Projector / speaker
 - A few commercials
 - Ice Cream, Burger, Roasted Chicken Ad
- Handouts: (bring 15 copies of Level 1 as well)**
- Mascots – have a few for new participants
 - Scavenger Hunt Handout

- PI Investigator Notes Handout (Common Attention Getters in Advertising & 7 Questions -double sided handout)
- Take Home Bags (20)**
- Level 2 – Go Card
 - Level 2 – Challenge
 - Recipe Card with Nutrition Facts on the Back
 - Website QR code card
 - Parent Envelope and insert
 - Cans of pineapple in juice
 - Also include prepacked Level 1 bags for new participants (15 bags)
- Food**
- Kooky-Cheese Fruity Kabobs
 - Orange Juice
 - Blue Food Coloring
 - Cups
 - Small paper plates, napkins, spoons, forks, etc. as needed
 - Sanitizer wipes
- Tip/Question – Poster (bring level 1 poster as well)**
- Fill half your plate with fruits and vegetables
 - How many cups of fruit should you have each day?
- Text Messages**
- Vegetable:
 - Sugar Added Beverages:
 - Exercise:

FuelUp&Go! Session 2

Be a Product Investigator

Total Session Time: 1 hour

Setup

- Post the clue on the front wall
 - Clue – I’m **not** an **apple** or a **pear** but I have a **tropical flare**. I’m **spiny** outside but **sweet and juicy**, one taste and you can’t refuse me. Say **aloha** to this week’s fruit eat it **fresh, frozen, canned** or **juiced!** What am I?

- Post this week’s Tip Sheet on the front wall
- Post Score Board on the front wall

- Sign-In Sheet
 - If new teens come UMass team members bring them up to speed
 - Sign-in Sheet
 - Assent Form
 - Surveys (FFQ and KAP)
 - Setup app – follow instructions
 - Pick mascot – name and powers

- Set out snack (Kooky Cheesey Fruity Kabobs in the center of the table)
 - **Invite teens to grab a snack before session starts**

- Place take home bags in the back of the room so teens can see but won’t see what’s in them. (session 1 and session 2 bags)

- Place handouts in the center of the table so they are easily accessible

- Set out pencils in the center of the table

- Turn music on** so it plays in the backgrounds as teens come in.

FuelUp&Go! Session 2

Be a Product Investigator

Opening and Flashback

Time: 5 minutes

Play music. Greet the teens energetically.

NOTE: Orient new students while waiting to start

FuelUp&Go! Flashback: Note: This needs to be energetic!

Review the following

1. Challenge – Find two food ads, one for a beverage

Ask:

- Why did you pick these ads?
- What are the ads selling?
- Do you want to buy these items? Why or why not?
- How easy or hard was it to find an ad about fruits or vegetables?
- We'll come back to these ads later in this session

2. Go Card

Ask, "How did you do with your Go Cards?" Then ask the teens to make sure their names are on their cards, and then have them turn their cards in so you can calculate and record their Go Points.

Collect Go Cards/Challenge Information

3. Review. Quickly review the main points from session 1:

- In session 1, we learned about the FuelUp&Go! program, selected mascots, took a few surveys and got setup on the app/fitness tracker
- Ask if anyone saw the Tip Poster from Level 1
 - What are the 5 Food Groups?
 - How much vegetable should you eat each day?
- What questions do you have about session 1?
 - How did you do logging information on trackers?

4. Today you will all become PIs, PI stands for "Product Investigators."

Learning Task #1: Teens will discover the powers they have and that they want to build and discuss the impact of marketing on those powers.

Time: 10 minutes

What types of POWER do we have? Think back to what we talked about in session 1 when we talked about the powers we gave our mascots, powers of the mind and body

Who would like to call out some of those powers?

- **Powers of the mind**
- **Powers of the body.**

(Make sure that the teens include health and money.)

So if these are some of the powers that we have. How can buying a food, beverage, or other product affect our powers?

(Encourage the teens to say each of the following):

- Marketers want to sell us their products in exchange for our money.
- When we spend money, we are using up some of our money power.
- When we buy foods or beverages, we also make **choices** that affect our power by affecting our health.

Reinforce these points and add the following:

- **The goal is *BALANCE!* When we use up some of one power, it's smart to use it to build other powers.**
 - We want to use our CHOICES wisely so that we have BALANCE. For example:
 - It's okay to spend money. But what are some things that you can use your money for that might help you to build other powers?
 - Examples might include healthy foods (fruits & vegetables instead of sugary/salty snack foods), equipment or music for exercise
 - It's okay to watch some TV. But what can we do to keep that in balance?
 - It's okay to have a sugar added beverage but if the beverage is replacing a healthy item or if you have too much of a sugar added beverage this can reduce your healthy powers.

Stress that all buying and selling is just a form of trading. We give up one thing to get another. All marketing isn't necessarily bad it's just meant to do a job – get you to buy a product!

FuelUp&Go! Session 2

Be a Product Investigator

Wrap up Learning Task #1: The two important things to remember here are:

1. The choices that we make affect our POWER.
2. Our choices include both WHAT to buy and WHETHER to buy.

Learning Task #2: Teens will list places where marketers try to get their attention.

Time: 10 minutes

Let's talk about power, choice and marketing now.

Activity #1: You are the marketers!

EXPLAIN: We have all seen advertising. But what would it be like to be on the OTHER side of the fence – to be the people who DO the advertising? Let's pretend you're on the **Executive Board of a beverage company** like Coca Cola, Pepsi, or Snapple!! Your goal is to get as many customers to buy your beverage as you can. In other words, you want to influence people's choices to build your own power. Money is no object!

How would you advertise your beverage?

Facilitator: Below is a list of the kinds of things we are looking for as ways to advertise a line of beverages.

PROMPT: If the teens did not mention them, ask "What about...?"

- Making sure your beverages taste great!
- Making sure everyone knows the brand of your beverages (this is called, "Brand Recognition")
- Designing advertising that will "stick in people's heads," such as through the use of music or humor.
- Aiming your ads at people who are most likely to drink your beverages (Children? Teens? Families? Mostly just adults?)
- Designing a really "cool" package for you beverages (e.g., if you are trying to attract children or if you're trying to attract teens, perhaps a game room)

Ask the groups: Why would you want to get as many customers to buy your product? (Answer: MONEY!) MONEY is one kind of power.

Activity #2: Marketing Scavenger Hunt

Handout: Marketing Scavenger Hunt

FuelUp&Go! Session 2

Be a Product Investigator

EXPLAIN: We've just talked about how important it is to get people to know a product name or brand. To show how often companies do this, we're going to have a Marketing Scavenger Hunt. I'm going to give you about 5 minutes to walk or look around the room and see how many logos or brand names you can find. When you find one, you can write it down on your Scavenger Hunt Handout. (NOTE: When you see something, don't take it, move it, or call attention to it in any other way.)

Use your Scavenger Hunt handout to keep track of what you see.

Make sure the following items are in sight around the room:

- An item of clothing (e.g., t-shirt and/or sneakers/running shoes) with a logo
- A backpack with a logo
- A soft drink container
- A movie character folder or notebook
- Other items with logos or promotional info – magnets, book covers, logos on printed materials (e.g., posters).

After 2-3 minutes, ask the groups to get back together. Ask each group how many items they found with brand names or logos (just the number, not the list). Invite people to **call out** the specific items that they found, and list them on newsprint. (NOTE: if you are aware of any items that they overlooked, quickly challenge them to look around the room from their seats, to see if they can find them.)

Are YOU an advertiser?

- Do you ever wear clothes that have a name or logo? (e.g., t-shirts, shorts, etc.)?
- Do you drink from bottles or cups with logos?
- Do you ever talk to a friend about a funny or cool commercial?
- Do you ever forward funny ads to others on the internet, or even suggest game sites that have ads?

Just think! You buy the product AND give the brand free advertising! Don't you think they should pay YOU to wear their logo?

Where else do advertisers try to reach us?

- Do you see ads in your schools (e.g., Channel One)?
- On your bus?
- In movies?
- On the internet/websites?
- Billboards, including in athletic fields?
- Radio?
- Fundraisers?
- Vending machines?

FuelUp&Go! Session 2

Be a Product Investigator

Wrap up Points for Learning Task #2: Here are two important things to remember:

1. Marketers want to make money from YOU. They will do this by trying to sell you their product.
2. One way they do this is to make sure their brand is always in sight.

Do the Exercise Circuits for Session #2. Turn on some appropriate music and MOVE! (Let's Get It Started)

Time: 5-10 minutes

Have the circuits be led by a team member while setting up for Learning Task #3

Stations- Each station is set up for a different exercise/activity; split up the teens into groups so everyone is at a station (equal number of teens at each one). After explaining each stations activity, music will be the cue for students to start/stop their exercise (like musical chairs)! When they hear a song change, that is their cue to head to the next station!

30 seconds of exercise- song change!

20 seconds of break/transition time (break song)

30 seconds of exercise- song change!

20 seconds of break/transition time (break song)

Stations include (one UMass Team member at each station):

- jumping jacks
- high knees (standing in place)
- frog jumps
- push ups (on knees)

If time allows it, go through stations twice!

After this is complete, stretch for 1 minute! (UMass team member leads this)

- Reach down and touch your toes
- Cross one straight arm across body and use other arm at a right angle to pull towards body (Both arms)
- Stand on one foot and stretch quad by bending knee and holding up one foot behind body
- Deep breaths

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FuelUp&Go! Session 2

Be a Product Investigator

Learning Task #3: Teens will identify strategies that marketers use to complete for the teens' POWER.

Time: 15 minutes

Get back into one large group. Introduce this Activity: Before our exercise break we talked about PLACES where companies put their brands and ads. Now let's talk about HOW they persuade us to buy their products. Let's take a look at some real commercials.

Pass out PI Handout

On the back side of your Marketing Scavenger Hunt Handout, you'll see a table called "Detective Notes". Use this table to write down the ways that each of the commercials we are about to see tries to get your attention.

- **Show a few beverage commercials** - ask a team member to have this setup and ready to go on the computer while learning task #2 is happening or setup at the beginning of the session
 - <https://www.youtube.com/watch?v=HUzPwIP9BqE> – coke bottles with names
 - https://www.youtube.com/watch?v=jzTCPx_fsPs – Pepsi - Marshawn Lynch
 - <https://www.youtube.com/watch?v=mjwUVZHBcoY> – Mountain Dew
- If can't show the commercials on computer have some ads to pass out to teens.

After the teens have finished writing down the ways these commercials tried to get their attention, invite them to share their reactions.

Ask:

- Did any of these ads provide information? (Answer is probably no.) Ask: Why don't commercials give much information?

Look at the bottom of the page underneath your detective notes there is a list of Common Attention Getters in Advertising.

Invite the teens to write in other attention-getters they saw today on the line beside "What else?"

Now let's look deeper. This is where your PI powers really go to work

Look at the first page of the handout. Here are listed the 7 PI questions about media. These are the questions you should ask yourself when looking at products.(Have the teens follow along):

1. Who is behind this? (Who is the sponsor?)
2. Who is this for? (Are they talking to me?)
3. What is their goal? (Are they selling me something?)

FuelUp&Go! Session 2

Be a Product Investigator

1. What are they telling me?
2. What are they NOT telling me? (NOTE: We already mentioned that they usually leave out information.)
3. How are they trying to get my attention? e.g., sound, color, humor, or use of well-known people. Different techniques work with different audiences.
4. **How will this item or information affect my POWER?**

So let's take **ONE** example from the ads we just saw, and see if we can answer these questions. Let's take the [choose a SSB] ad. (Go through the 7 questions).

NOTE: For question #7 (about how the item will affect their POWER), the answer will depend on the ad.

Now look at the ads you brought with you today (if the teens did). Would anyone like to share how one of your ads tried to sell their product to you? (Call out).

If have time

Let's flip this around and look at how one marketer tried to use these techniques for fruits and veggies

http://www.crookedbrains.net/2007/11/creative-ads-with-fruits-vegetables_15.html. These are creative funny ads for fruits and vegetables.

Wrap up points for Learning Task #3: Here are three important things to remember:

1. Marketers use many different tactics to sell you their products and get your money.
2. By knowing about these tactics you have more POWER – PI POWER!!
3. Having a strong personal identity can also help you resist advertising tactics. **You don't have to fall for the image that they show.** Think about the powers you gave your mascot – the real ones and the fantasy ones, and think about the powers you are building here. Knowing your powers helps you build a personal identity.

FuelUp&Go! Session 2

Be a Product Investigator

Learning Task #4: Teens will explore how their senses can be impacted by marketing

Time: 5 minutes

Have a team member prepare this during Learning Task #3 so it is ready to go.

Without letting the teens see what you are preparing, add blue food coloring to orange juice until it turns green. Pour out several small cups of juice (in clear or semi-clear cups) and ask the teens to try this. Take a sip yourself.

Some teens will probably be reluctant. Ask why? Then invite the group to guess what the beverage might be.

Point out that our senses are important to use in helping us to decide what to eat and drink.

Marketers know this, so they go out of their way to make foods look really great on commercials. But what are we really looking at?

To make food look especially good, marketers often use ingredients that are not food at all! Who would like to guess what food the following ingredients can be made to look like, under the bright lights of film or photography?

Ingredients:

- Shortening
- Powdered sugar
- Corn syrup
- Vanilla beans, strawberry jam, cocoa or other coloring and flavorings

Answer: Ice Cream! (Show an ad for ice cream if you can.) *[NOTE: Use pictures to illustrate these fabricated foods more dramatically.]*

Here are some other foods that advertisers fix up to look unusually good under the lights of the cameras. *[NOTE: mention if time allows.]*

- The perfect burger is made by ... gluing individual sesame seeds to the bun using tweezers and glue, paint the meat with brown food coloring or molasses, and using waterproof spray and glycerin (a syrupy, sweet liquid made from oil) to make it look juicy.
- A beautiful roasted chicken is made by... tying the skin up tight with a needle and thread, paint it with red and brown food coloring or molasses mixed with water, oil and a drop of soap, and then browning it with a blowtorch.
- The “milk” on the front of cereal boxes is really glue and water!
 - Ask: Can anyone tell me why this isn’t considered false advertising?
 - Answer: Marketers can get away with this because they’re advertising the cereal, not the milk!

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FuelUp&Go! Session 2

Be a Product Investigator

Wrap up Learning Task #4: The important thing to remember here is **THINGS ARE NOT ALWAYS WHAT THEY SEEM.**

Closing

Time: 5 minutes

1. Ask teens about the recipe (Kooky Cheesy Fruity Kabobs)

- Is this something you could make at home? What other ideas do you have for the recipe?
- Ask them to guess the clue if they haven't already come up with the answers
- Review this week's tips
 - i. Make half your plate fruits and vegetables
 - ii. How many cups of fruit should you eat?

a. Handout the take home bags

- i. Let teens know the bag is packed with the secret fruit along with a recipe card and a few other pieces of information. Explain that the bags are for the teens to share with their families, and they can show them the recipe they tried today.

b. Go Card

Remind the teens that they can set their own goals if they want. And they will earn 3 points for completing a row/column and 15 points for completing the whole card. Bring your card back next week to get your points.

c. Weekly Challenge.

The Challenge is:

Design advertising for a fruit or vegetable

We can use what we learned to create attention getting advertising for fruits and vegetables.

Tell teens this link is posted on line. <http://www.producenews.com/news-dep-menu/test-featured/15212-prepare-to-be-marketed-to>

- Choose a fruit or vegetable
- A package for your fruit/vegetable
- A design for your package, including a character or picture
- A name for your fruit/vegetable
- A creative description

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FuelUp&Go! Session 2

Be a Product Investigator

- Want to put a prize inside?
- Make your fruit and vegetable sound great or funny, but make it something EVERYONE wants to buy! Bring it to session #3.
- **Ask the teens what questions they have about their CHALLENGES.**

a. Website Card

- I've attached another website card just in case you needed another

b. Let teens know about the weekly text messages which will start this week.

2. Ask the teens what questions they have about their FuelUp&Go! Challenges

- Wrap up: I had a great time with you today! What questions do you have about FuelUp&Go!
- What's one thing you would tell someone about FuelUp&Go!
- Remind teens to upload information for wearable technology
- Remind teens to visit the website
- We'll meet here again next _____(date) at _____(time).
- Have teens sign out and get gift cards.
- Don't forget to record Go Points for the teens.

APPENDIX I

PARENTAL CONSENT

Parental Permission for Participation in a Research Project
University of Massachusetts Amherst

Researcher(s):	Dr. Elena Carbone, Catherine Wickham
Project Title:	FuelUp+Go!
Funding Agency:	This project is funded by a grant from the Academy of Nutrition and Dietetics and General Mills Foundations

1. WHAT IS THIS FORM?

This form is called a Consent Form. This consent form will give you the information you will need to understand why this project is being done and why you and your child are being invited to participate. It will also describe what you and your child will need to do to participate and any known risks, inconveniences or discomforts that may occur while participating. We encourage you to take some time to ask questions now and at any other time. If you decide to allow your child to participate, you will be asked to sign this form and you will also be given a copy for your records.

2. WHO IS ELIGIBLE TO PARTICIPATE?

Children must be at least 11 years old, have access to a computer and a smartphone, be able to speak and read English, live in Springfield, and have permission of a parent/guardian to participate. Parents or guardians of a participating child are also invited to enroll in the program.

3. WHAT IS THE PURPOSE OF THIS PROJECT?

Children make choices about the foods and beverages they consume every day. FuelUp+Go! will help them learn more about the choices they have and how these choices affect their health. We also hope that this program will provide you and your child with information and resources to help support your child's healthy choices.

4. WHERE WILL THE PROJECT TAKE PLACE AND HOW LONG WILL IT LAST?

The program will take place in Springfield, MA. Your child's participation in the program will take about 1 hour per week for six weeks. If you decide to join the program we anticipate that your participation will take about 1 to 2 hours total over the course of the program.

5. WHAT WILL MY CHILD BE ASKED TO DO?

If you and your child agree to work with us, you will both take part in a fun, interactive program which includes many activities. Your child may be asked to do all or some of the following: use an app to track the foods he/she consumes, wear a Move Up fitness tracker to track physical activity, visit a website, receive weekly motivational and educational text-messages, and participate in 6 – 1 hour workshops. The workshops are a way for us to connect to participants, to answer questions, get feedback on the project, provide program information, and update your child on his/her progress. At the beginning and end of the program your child will also be asked to fill out a food frequency questionnaire and a short survey on their nutrition and physical knowledge, attitudes and behaviors. We will provide your child with a free Move Up fitness tracker. Over the course of the project your child will also have the ability to earn points which can be turned in for special gifts such as water bottles, jump ropes, Frisbees, and more. In addition, he/she will earn a \$5.00 Amazon gift card for each workshop attended.

Because your children's opinions count we want them to help guide the direction of the program. Your child will be asked if he/she would like to join a special Kid Council (KC). This council will meet separately from the workshops. If your child joins the KC he/she will be asked to give his/her opinion on a variety of different topics that may be used in the program. Entry into the KC will be on a first come basis as the group is limited to 12 people. These sessions will last about 30-45 minutes and will be audio-taped. If your child does not wish to be audio-taped or if you do not want your child audio-taped he/she will not be able to join the KC. KC members may also be asked to give their opinions about the program online (by email). Should your child join the KC he/she will receive a \$20 iTunes gift card for each KC meeting.

University of Massachusetts Amherst-IRB (413) 545-3428	
Approval Date: 08/03/2015	Protocol #: 2015-2578
Valid Through: 06/30/2016	
IRB Signature: <i>Yang C. Shultz</i>	

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University of Massachusetts Amherst

6. WHAT WILL I BE ASKED TO DO?

At the beginning and end of the project we will ask you to fill out a short home food inventory that focuses on fruits, vegetables, and beverages. As a thank you for completing these inventories you will receive a \$5 grocery store gift card for each inventory submitted. At the mid-point of the program, we also invite you to participate in a 1-hour in-person focus group so that we can get your feedback on the program's progress. For participating in the focus group you will receive an additional \$20 grocery store gift card. Focus groups sessions will be audio-taped.

6. WHAT ARE THE BENEFITS OF BEING IN THIS PROJECT?

Your child may learn new skills that will help him/her build strength and power to make choices about the foods and beverages they eat and the amount of physical activity they do. These skills are important in setting the foundation for lifelong healthy choices. We also hope that you will learn information that will help you support your child's choices.

7. WHAT ARE THE RISKS OF BEING IN THIS PROJECT?

There are no known risks to you or your child associated with this project.

8. HOW WILL MY CHILD'S PERSONAL INFORMATION BE PROTECTED?

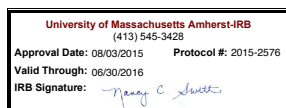
Please note that KC meetings and focus groups will be audio-taped. This will help us remember everything that is said during the sessions. Those who do not want to be audio-taped will not be able to participate in either the KC or focus groups; however, it is still possible to participate in other activities.

Please be advised that although the project team will take every precaution to maintain confidentiality of the data from the app and in-person workshops, but the nature of group activities conducted at in-person workshops prevents the team from guaranteeing confidentiality of what is discussed during the session. The app is password protected and the data will be available only to members of the project team.

The following process will be used to protect the confidentiality of the information collected as part of this project. The researchers will keep all audio-tapes, interview notes, and any codes to the data, in a secure location at the University of Massachusetts. Your child's name will be kept confidential. All information will be labeled with a code. A key that links names and codes will be kept in a separate and secure location. The key will be destroyed three years after the end of the project. All electronic files including data bases, spreadsheets and statistical analysis containing identifiable information will be password protected. Any computer hosting such files will also have password protection to prevent access by unauthorized users. Only the members of the project team will have access to the passwords. At the end of this project, the researchers may publish their findings. Information will be presented in summary format; neither you nor your child will be identified in any publications or presentations. Data from this project will be shared with the research team, the Nutrition Department and the School of Public Health and Health Sciences at the University of Massachusetts, Amherst.

9. WHAT IF MY CHILD OR I HAVE QUESTIONS?

If you or your child has questions about this project or if you have a research-related problem, you may contact the researchers: Dr. Elena Carbone (ecarbone@nutrition.umass.edu) or Catherine Wickham (cwickham@schoolph.umass.edu). If you have any questions concerning your child's rights or your rights as a project participant, you may contact the University of Massachusetts Amherst Human Research Protection Office (HRPO) at humansubjects@ora.umass.edu.



Parental Permission for Participation in a Research Project
University of Massachusetts Amherst

10. CAN I OR MY CHILD STOP BEING IN THE PROJECT?

Yes. Your child does not have to be in this project if you or your child does not want to be and you do not have to participate in this project if you do not want to. If you agree to allow your child to participate, but later you or your child change your mind, he/she may drop out at any time. You may also drop out of the program at any time. There are no penalties or consequences of any kind if you decide that you do not want to participate and/or you do not want your child to participate.

12. SUBJECT STATEMENT OF VOLUNTARY CONSENT

By signing this form I am agreeing to voluntarily allow my child to participate in this project. I also understand that I can agree to voluntarily enter the program if I check yes below. I have had a chance to read this consent form, and it was explained to me in a language which I use and understand. I have had the opportunity to ask questions and have received satisfactory answers. I understand that I can withdraw my child at any time and I can choose to stop participating. A copy of this signed Informed Consent Form has been given to me.

Please fill out the information below if you would like your child to participate in the program.

- I agree to have my child join the Kid Council. Yes No
- I agree to have my child be audio-taped during the Kid Council. Yes No
- I agree to have my child participate in the FuelUp+Go! Program. Yes No

Parent/Guardian Signature Print Name Date

Child's Name Child's Email Address Child's Cell Phone Number

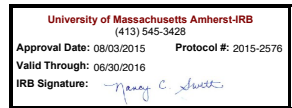
Please fill out the information below if you would like to participate in the program.

- I agree to participate in the FuelUp+Go! Program Yes No

Your Email Address Your Cell Phone Number

By signing below I indicate that the participant has read and, to the best of my knowledge, understands the details contained in this document and has been given a copy.

Signature of Person Print Name Date
Obtaining Consent



APPENDIX J

ASSENT FORM

Assent Form for Participation in a Research Project
University of Massachusetts Amherst

Researcher(s): Dr. Elena Carbone, Catherine Wickham
Project Title: FuelUp+Go!
Funding Agency: This project is funded by a grant from the Academy of Nutrition and Dietetics and the General Mills Foundations

We want to tell you about a project we're doing to help you understand more about foods you come in contact with every day. You have the strength and power to make choices about the foods and beverages you eat and drink. FuelUp+Go! will help you learn more about the choices you have and how they affect your strength and power.

If you agree to work with us, you will take part in a fun, interactive program. You may be asked to do some or all of the following:

- Use an app to track the foods you eat
- Wear Move Up a fitness tracker
- Visit a website
- Receive weekly motivational and educational text-messages
- Participate in six fun and interactive 1-hour workshops

The workshops will be a great way for us to connect and answer your questions, get your input, provide program information, and update progress. At the beginning and end of the program you will also be asked to fill out a survey about the fruits and vegetables you eat and the beverages you drink as well a short survey on your nutrition and physical activity knowledge, attitudes and behaviors.

Your opinion counts, so we'll be forming a special Kid Council (KC) to help guide the direction of the program. If you choose to join the KC you will be asked to give your opinion on a variety of different topics that may be used in the program. Entry into the KC will be on a first come basis as the group is limited to 12 people. KC meetings will last 30-45 minutes and will be audio-taped. Because we can't stop and start the audio-tape during these meetings if you don't want to be audio-taped you will not be able to participate in the KC. KC members may also be asked to give their opinions about the program online (by email). You will receive a \$20 iTunes gift card for attending each KC meeting.

The FuelUP+Go! program will take place in Springfield, MA. Participating in the program will take about 1 hour a week for six weeks. We will give you a free Move Up fitness tracker at the beginning of the program. Over the course of the program you will have the chance to earn points which can be turned in for special prizes such as water bottles, jump ropes, Frisbees, and more. You will get a \$5.00 Amazon gift card for each in-person workshop you attend.

You can stop being part of the project at any time. You can say okay now and change your mind later. All you have to do is tell us you want to stop. No one will be mad at you if you don't want to be in the project or if you join the project and change your mind later and ask to stop. Your parent or guardian already knows about this project and that we're asking if you would like to be part of it.

University of Massachusetts Amherst-IRB (413) 545-3428	
Approval Date: 08/03/2015	Protocol #: 2015-2576
Valid Through: 06/30/2016	
IRB Signature: <i>Nancy C. Smith</i>	

**Assent Form for Participation in a Research Project
University of Massachusetts Amherst**

Before you say **yes or no**, we'll answer any questions you have. If you join the project, you can also ask us questions any time. If you have any questions after you leave here today you can contact the researchers Dr. Elena Carbone (ecarbone@nutrition.umass.edu) or Catherine Wickham (cwickham@schoolph.umass.edu). If you have any questions about your rights as a participant, you can contact the University of Massachusetts Amherst Human Research Protection Office (HRPO) at humansubjects@ora.umass.edu.

If you would like to be part of this program, please fill-out the information below.

I would like to join the Kid Council (KC). Yes No

I agree to be audio-taped at the Kid Council. Yes No

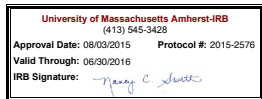
I would like to be part of the FuelUp+Go! Program. Yes No

Signature _____ Date _____

Your Name (print) _____ Date _____

Email Address _____ Cell Phone Number _____

Name of Person obtaining consent _____ Date _____



APPENDIX K

ADAPTED YOUTH AND ADOLESCENT FOOD FREQUENCY QUESTIONNAIRE FOR PILOT

Youth and Adolescent Food Frequency Questionnaire

*This questionnaire will help us understand what you typically drink and eat over the course of a month. Answer the questions based on what you drank or ate **over the past month**. Remember, that there are no right or wrong answers. Just try and think about what you drank or ate over the past month.*

*The first set of questions asks about how often you drank different beverages **over the past month**.*

Check (✓) only one box per row.

DRINKS

	Never/less than 1 a month	1-3 times a month	1 time a week	2-4 times a week	5-6 times a week	1 time a day	2 times a day	3 or more times a day
Diet Soda								
Regular Soda								
Sugared Iced-Tea								
Fruit Drinks/Punch – NOT FRUIT JUICE								

Adapted from the following source: Rockett, H.R., A.M. Wolf, and G.A. Colditz Development, and reproducibility of a food frequency questionnaire to assess diets of older children and adolescents. J Am Diet Assoc. 1995. 95(3): p. 336-40.

Youth and Adolescent Food Frequency Questionnaire

	Never/less than 1 a month	1-3 times a month	1 time a week	2-4 times a week	5-6 times a week	1 time a day	2 times a day	3 or more times a day
Kool-Aid								
Sports Drink (like Powerade or Gatorade)								
Vitamin Water								
Sugar-Free or Low Calorie Energy Drinks (like Red Bull Sugarfree, Lo-carb Monster Energy)								
Regular Energy Drinks (like Red Bull, Rock Star)								
Water – Tap and Bottled								

Youth and Adolescent Food Frequency Questionnaire

	Never/less than 1 a month	1-3 times a month	1 time a week	2-4 times a week	5-6 times a week	1 times a day	2 times a day	3 or more times a day
White Milk (any type)								
Chocolate or Other Flavored Milk								
Orange Juice								
Apple Juice and other 100% Fruit Juices								
Tomato Juice								
V8 Fusion								


Youth and Adolescent Food Frequency Questionnaire

	Never/less than 1 a month	1-3 times a month	1 time a week	2-4 times a week	5-6 times a week	1 times a day	2 times a day	3 or more times a day
Hot Tea with Caffeine (not herbal)								
Herbal Tea								
Decaffeinated coffee								
Coffee – not decaf.								
Coffee drinks with nonfat milk (like a Cappuccino, Mocha, or Late)								
Coffee drinks with low-fat or whole milk (like Cappuccino, Mocha, Latte)								
Iced Coffee drinks (like Coffee Coolatta, Frappuccino)								

Youth and Adolescent Food Frequency Questionnaire

What is the usual serving size of the soda you drink (any type)?

- Less than 12 ounces (oz.)
- 12 oz. (1 regular can)
- 16-20 oz. (1 bottle)
- 20+ oz. (e.g., Big Gulp)
- Don't know
- Don't drink soda

Continue on to the next page 

Adapted from the following source: Rockett, H.R., A.M. Wolf, and G.A. Colditz Development, and reproducibility of a food frequency questionnaire to assess diets of older children and adolescents. *J Am Diet Assoc.* 1995. 95(3): p. 336-40.

5

Youth and Adolescent Food Frequency Questionnaire

The next set of questions asks about what fruits you ate over the past month.

Check (✓) only one box per row.

FRUITS

	Never/less than 1 a month	1-3 times a month	Once a week	2-4 times a week	5-6 times a week	1 or more times a day
Apples						
Applesauce						
Bananas						
Blueberries						
Cantaloupe, melon, watermelon						
Dried fruit (like raisins and banana chips)						
Grapes						
Grapefruit						
Kiwi						
Mixed fruit/fruit cocktail						
Oranges						
Peaches, plums, apricots						
Pears						
Pineapple						
Raspberries						
Strawberries						
Tangerines/Clementines						

Adapted from the following source: Rockett, H.R., A.M. Wolf, and G.A. Colditz Development, and reproducibility of a food frequency questionnaire to assess diets of older children and adolescents. J Am Diet Assoc. 1995. 95(3): p. 336-40.

Youth and Adolescent Food Frequency Questionnaire

The next set of questions asks about what vegetables you ate over the past month.

Check (✓) only one box per row.

VEGETABLES

	Never/less than 1 a month	1-3 times a month	1 time a week	2-4 times a week	5-6 times a week	1 or more times a day
Asparagus						
Avocado						
Beans (like pinto beans, black beans, kidney beans) or lentils						
Beets						
Broccoli						
Cabbage						
Carrots						
Cauliflower						

Youth and Adolescent Food Frequency Questionnaire

	Never/less than 1 a month	1-3 times a month	1 time a week	2-4 times a week	5-6 times a week	1 or more times a day
Celery						
Coleslaw						
Collard greens/kale/cooked spinach						
Corn						
Cucumbers						
Green beans/String Beans						
Green/red/yellow peppers						
Lettuce/tossed salad						
Mixed Vegetables (like peas and carrots)						
Okra						

Youth and Adolescent Food Frequency Questionnaire

	Never/less than 1 a month	1-3 times a month	1 time a week	2-4 times a week	5-6 times a week	1 or more times a day
Peas						
Potatoes (not counting chips or French fries)						
Spinach, raw as in salad						
Tomatoes						
Yams/sweet potatoes						
Zucchini, summer squash, eggplant						

Youth and Adolescent Food Frequency Questionnaire

Demographics

How old are you? _____

Are you:

- Male
- Female

Are you Hispanic or Latino?

- Yes
- No
- Don't know/not sure
- I'd rather not say

Which one or more of the following would you say is your race? (Check all that apply)

- White
- Black or African American
- Asian
- Native Hawaiian or other Pacific islander
- American Indian or Alaska Native
- Other (please specify) _____
- Don't know/Not sure
- I'd rather not say

What is your Mascot's name _____

Thanks for completing this survey!

APPENDIX L

KNOWLEDGE ATTITUDE AND BEHAVIOR SURVEY - PILOT

Knowledge, Attitude, and Behavior Survey for Participants

This survey will ask you questions about your nutrition and physical activity knowledge as well as how you feel about certain foods and types of physical activity. There are no right or wrong answers.

KNOWLEDGE

Answer the following questions about nutrition and physical activity. Please choose only one answer per question.

What are the 5 food groups in MyPlate?

- Protein, Fat, Grains, Dairy, Vegetables
- Protein, Grains, Dairy, Fruits, Vegetables
- Protein, Milk, Fat, Legumes, Grains
- Protein, Grains, Vegetables, Fruits, Milk

100% fruit juice is considered part of the fruit food group.

- Yes
- No
- Not sure

How many cups of vegetables should you eat each day?

- 1
- 2
- 2-3
- 4 or more

How many cups of fruit should you eat each day?

- 1
- 2
- 2-3
- 4 or more

Which of these represents one cup from the vegetable group?

- 1 cup of raw vegetables
- 1 cup of cooked vegetables
- 2 cups raw leafy greens
- All of these
- None of these

How many teaspoons of sugar does the average American consume in a day?

- 9
- 13
- 17
- 22

Knowledge, Attitude, and Behavior Survey for Participants

On a food label how many teaspoons is one gram of sugar?

- ¼ teaspoon
- 1 teaspoon
- 2 teaspoon
- 1 tablespoon

Which of the following counts as sugar?

- honey
- high fructose corn syrup
- dextrose
- brown rice syrup
- all of the above

On average, a 20 oz. bottle of soda has how many teaspoons of sugar?

- 1 tsp
- 4 tsp
- 8 tsp
- 12 tsp
- 16 tsp

ATTITUDE

The following questions ask how you feel about fruits, vegetables, beverages, and physical activity. Place only one √ per row.

	A lot	A little	Not very much	Not at all
How much do you like fruit?				
How much do you like vegetables?				
How much do you like water?				
How much do you like sugar sweetened beverages like soda or kool-aid?				
How much do you like to do physical activity like dancing, jumping rope, walking, playing baseball, swimming, riding a bike?				

	Totally agree	Agree	Disagree	Totally disagree
Fruit tastes good.				
Vegetables taste good.				

Knowledge, Attitude, and Behavior Survey for Participants

Water tastes good.				
Physical activity like dancing, jumping rope, walking, playing baseball, swimming, riding a bike is fun.				

	Great	Good	OK	Not Good
How do you feel about trying new fruits?				
How do you feel about trying new vegetables?				
How do you feel about drinking more water each day?				
How do you feel about doing physical activity?				

Behaviors

The following questions ask about the choices you make in eating fruits and vegetables, drinking beverages, and doing physical activity. Place only one \checkmark per row.

Fruits

	Definitely	Probably	Probably not	Definitely not
Will you taste a fruit if you don't know what it is?				
Will you taste a fruit if you don't recognize it?				
Will you taste a fruit if you have never tasted it before?				
When you are at a friend's house, will you try a new fruit?				
When you are at school, will you try a new fruit?				
When you are at home, will you try a new fruit?				

	Never	1 time	2 times	3 times	At least 4 times
How many times in the last month have you tried a new fruit?					

	Very likely	Likely	Maybe	Not likely	I don't eat fruit
How likely are you to eat fruit today?					

Knowledge, Attitude, and Behavior Survey for Participants

Vegetables

	Definitely	Probably	Probably not	Definitely not
Will you taste a vegetable if you don't know what it is?				
Will you taste a vegetable if you don't recognize it?				
Will you taste a vegetable if you have never tasted it before?				
When you are at a friend's house, will you try a new vegetable?				
When you are at school, will you try a new vegetable?				
When you are at home, will you try a new vegetable?				

	Never	1 time	2 times	3 times	At least 4 times
How many times in the last month have you tried a new vegetable?					

	Very likely	Likely	Maybe	Not likely	I don't eat vegetables
How likely are you to eat a vegetable today?					

Drinks & Physical Activity

	Definitely	Probably	Probably not	Definitely not
Will you drink water instead of sugar sweetened beverages if you have the choice?				

How many days per week do you do physical activity such as dancing, jumping rope, walking, playing baseball, swimming?

- Less than one day
- 1 day
- 2 days
- 3 days
- 4 days
- 5 days
- 6 days
- Every day

Knowledge, Attitude, and Behavior Survey for Participants

How many minutes each day do you participate in physical activity such as dancing, jumping rope, walking, playing baseball, swimming each day?

- Less than 30 minutes
- 30 minutes
- 60 minutes
- More than 60 minutes

APPENDIX M

WEBSITE LANDING PAGE



APPENDIX N

SAMPLE FOOD CLUE



FuelUp&Go!

Level 2 Clue

I'm not an **apple** or a **pear**
but I have a **tropical flare**.

I'm **spiny** outside but
sweet and juicy, one taste
and you can't refuse me.
Say **aloha** to this week's
fruit eat it **fresh, frozen,**
canned or juiced!

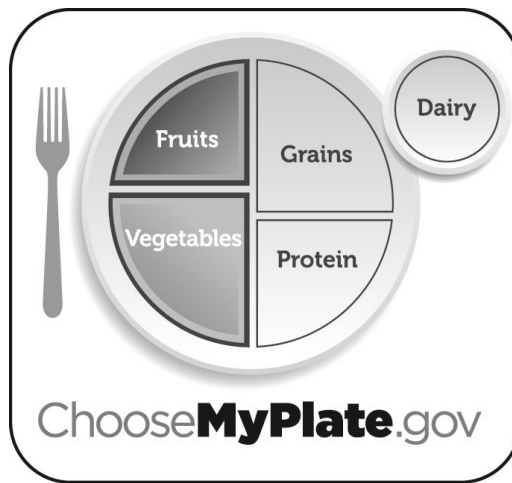
What am I?

APPENDIX O

SAMPLE WEEKLY TIP

FuelUp&Go!

Level 2 Tip



Question

How many cups of fruit should you have each day?



FuelUp&Go!

Product Investigator Notes

Before you act on media, be a PI and ask yourself these 7 questions:

1. **WHO** is paying for this? (Who is the sponsor?)
2. **WHO** is this for? (Are you talking to me?)
3. **WHAT** is their goal? (Are you selling me something?)
4. **WHAT** are they telling me?
5. **WHAT** are the NOT telling me?
6. **HOW** are they trying to get my attention?
7. **HOW** will this information or item affect my **POWER?**

REMEMBER—Sellers want your money!!

APPENDIX Q
SAMPLE CHALLENGE

FuelUp&Go! Challenge: Level 2

What You Need to Do

1. Choose a fruit or vegetable
2. Design packaging for your fruit/vegetable
 - a. Would you include a character or picture?
 - b. What colors would you include?
 - c. Information?
3. Come up with a cool, fun name and a creative description
4. Would anything come with your fruit/vegetable like a prize, games, etc
5. **Bring your designs to our next session!**



FuelUp&Go! Challenge: Level 2

What You Need to Do

1. Choose a fruit or vegetable
2. Design packaging for your fruit/vegetable
 - a. Would you include a character or picture?
 - b. What colors would you include?
 - c. Information?
3. Come up with a cool, fun name and a creative description
4. Would anything come with your fruit/vegetable like a prize, games, etc.
5. **Bring your designs to our next session!**



APPENDIX R
SAMPLE RECIPE

FuelUp&Go! Recipe

2

Kooky Cheese-Fruity Kabobs

Serves 12

Ingredients:

1 pound medium strawberries, leaves removed, halved
¾ pound seedless grapes
1 15-ounce can pineapple chunks in juice, drained
1 pound of Cheddar, Swiss or other mild cheese, cut into cubes
24 coffee stirrers or large toothpicks

Directions:

1. Wash strawberries and grapes
2. Remove leaves from strawberries and cut in half
3. Drain pineapple
4. Cut cheese into 1 inch x ½ inch cubes
5. Place two pieces of cheese and each kind of fruit on each skewer, alternating different fruits between the cheese.

TIPS:

- Use bananas, apples, pears, or any fruit that is in season.
- If making ahead of time, squeeze lemon or lime juice on bananas and apples to prevent them from turning brown.

Nutrition Facts: Serving size: 2 skewers; Calories: 170; Fruits and Vegetables: 1 1/2; Fat: 8 g; Fiber: 1 g.

APPENDIX S

PROGRAM EVALUATION SURVEY

FuelUp&Go! Program Evaluation

1. What influences the decisions you make about the fruits you eat? **Circle all the answers that make sense for you.**
 - Taste
 - Texture (what it feels like in mouth)
 - Smell
 - If it's available at home
 - If it's available at school
 - Friends (if they eat it)
 - Family
 - Cost
 - Other _____

2. What influences the decisions you make about the vegetables you eat? **Circle all the answers that make sense for you.**
 - Taste
 - Texture (what it feels like in mouth)
 - Smell
 - If it's available at home
 - If it's available at school
 - Friends (if they eat it)
 - Family
 - Cost
 - Other _____

3. What influences the decisions you make about the sugar added beverages you drink? **Circle all the answers that make sense for you.**
 - Taste
 - Texture
 - Smell
 - Availability at home
 - Availability at school
 - Friends
 - Family
 - Cost
 - Other _____

FuelUp&Go! Program Evaluation

4. What influences the decisions you make about the amount of exercise you do? **Circle all the answers that make sense for you.**

- How tired I am
- Amount of homework I have to do
- Amount of time I want to spend watching TV or playing computer games
- What my Friends do
- What my Family does
- Other _____

We would like to know what you thought about different parts of this program. What did you think about each of the following?

5. **Wearing a fitness tracker**

Didn't Like at All	Didn't Like	Sort of Liked	Liked	Really liked a lot	Don't Know/Didn't Do
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6. **Syncing the fitness tracker to my phone**

Didn't Like at All	Didn't Like	Sort of Liked	Liked	Really liked a lot	Don't Know/Didn't Do
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. **Visiting the FuelUp&Go! Website**

Didn't Like at All	Didn't Like	Sort of Liked	Liked	Really liked a lot	Don't Know/Didn't Do
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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8. Getting text messages

Didn't Like at All	Didn't Like	Sort of Liked	Liked	Really liked a lot	Don't Know/Didn't Do
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9. Doing the weekly challenge

Didn't Like at All	Didn't Like	Sort of Liked	Liked	Really liked a lot	Don't Know/Didn't Do
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

10. Completing the weekly FuelUp& Go Card

Didn't Like at All	Didn't Like	Sort of Liked	Liked	Really liked a lot	Don't Know/Didn't Do
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

11. Tasting new weekly recipes

Didn't Like at All	Didn't Like	Sort of Liked	Liked	Really liked a lot	Don't Know/Didn't Do
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

12. Weekly food clue

Didn't Like at All	Didn't Like	Sort of Liked	Liked	Really liked a lot	Don't Know/Didn't Do
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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13. Weekly tip

Didn't Like at All	Didn't Like	Sort of Liked	Liked	Really liked a lot	Don't Know/Didn't Do
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

14. Weekly take home bags

Didn't Like at All	Didn't Like	Sort of Liked	Liked	Really liked a lot	Don't Know/Didn't Do
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

15. Learning about ways advertisers try and get my attention and money

Didn't Like at All	Didn't Like	Sort of Liked	Liked	Really liked a lot	Don't Know/Didn't Do
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

16. Learning about the 4 levels of protection

Didn't Like at All	Didn't Like	Sort of Liked	Liked	Really liked a lot	Don't Know/Didn't Do
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

17. Learning about Nutrition Facts Label, protectors and items from the dark side

Didn't Like at All	Didn't Like	Sort of Liked	Liked	Really liked a lot	Don't Know/Didn't Do
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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18. Learning about exercise and water

Didn't Like at All	Didn't Like	Sort of Liked	Liked	Really liked a lot	Don't Know/Didn't Do
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

19. Learning about sugar added beverages

Didn't Like at All	Didn't Like	Sort of Liked	Liked	Really liked a lot	Don't Know/Didn't Do
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Tell us what you did with the following items packed in your take home bags.

Check one answer per item.

20. Pineapple

- Ate them
- Gave them to my parents
- Gave them to a friend or family member
- Didn't use them/threw them away

21. Craisins

- Ate them
- Gave them to my parents
- Gave them to a friend or family member
- Didn't use them/threw them away

22. Apples

- Ate them
- Gave them to my parents
- Gave them to a friend or family member
- Didn't use them/threw them away

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23. **Chickpeas**

- Ate them
- Gave them to my parents
- Gave them to a friend or family member

Didn't use them/threw them away

24. **Diced Tomatoes**

- Ate them
- Gave them to my parents
- Gave them to a friend or family member

Didn't use them/threw them away

25. **Carrots**

- Ate them
- Gave them to my parents
- Gave them to a friend or family member
- Didn't use them/threw them away

26. **Bananas**

- Ate them
- Gave them to my parents
- Gave them to a friend or family member

Didn't use them/threw them away

27. What did you find the most difficult to do during the program? Why?

28. What was the easiest thing for you to do during the program? Why?

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29. What was your favorite thing you learned in the program?

30. If you could change one thing about the program what would you change?

31. What is one thing you learned in the program that you will use?

How will you use it?

Name _____

Thank You!

APPENDIX T

DIETARY INTAKE AND PHYSICAL ACTIVITY SURVEY WINTER AND SPRING PROGRAMS

Fruit, Vegetable, Beverages and Physical Activity Survey

The next 8 questions ask about food you ate or drank during the past 7 days. Think about all the meals and snacks you had from the time you got up until you went to bed. Be sure to include food you ate at home, at school, at restaurants, or anywhere. **Circle** only one answer per question. Think about each question carefully but remember **there are no right or wrong answers**.

1. **During the past 7 days, how many times did you drink 100% fruit juices such as orange juice, apple juice, or grape juice?** (Do not count punch, Kool-Aid, sports drinks, or other fruit-flavored drinks.)
 - a. I did not drink 100% fruit juice during the past 7 days
 - b. 1 to 3 times during the past 7 days
 - c. 4 to 6 times during the past 7 days
 - d. 1 time per day
 - e. 2 times per day
 - f. 3 times per day
 - g. 4 or more times per day

2. **During the past 7 days, how many times did you eat fruit?** (Do not count fruit juice.)
 - a. I did not eat fruit during the past 7 days
 - b. 1 to 3 times during the past 7 days
 - c. 4 to 6 times during the past 7 days
 - d. 1 time per day
 - e. 2 times per day
 - f. 3 times per day
 - g. 4 or more times per day

3. **During the past 7 days, how many times did you eat green salad?**
 - a. I did not eat green salad during the past 7 days
 - b. 1 to 3 times during the past 7 days
 - c. 4 to 6 times during the past 7 days
 - d. 1 time per day
 - e. 2 times per day
 - f. 3 times per day
 - g. 4 or more times per day

Fruit, Vegetable, Beverages and Physical Activity Survey

- 4. During the past 7 days, how many times did you eat potatoes?** (Do not count French fries, fried potatoes, or potato chips.)
- a. I did not eat potatoes during the past 7 days
 - b. 1 to 3 times during the past 7 days
 - c. 4 to 6 times during the past 7 days
 - d. 1 time per day
 - e. 2 times per day
 - f. 3 times per day
 - g. 4 or more times per day
- 5. During the past 7 days, how many times did you eat carrots?**
- a. I did not eat carrots during the past 7 days
 - b. 1 to 3 times during the past 7 days
 - c. 4 to 6 times during the past 7 days
 - d. 1 time per day
 - e. 2 times per day
 - f. 3 times per day
 - g. 4 or more times per day
- 6. During the past 7 days, how many times did you eat other vegetable?** (Do not count green salad, potatoes, or carrots.)
- a. I did not eat other vegetables during the past 7 days
 - b. 1 to 3 times during the past 7 days
 - c. 4 to 6 times during the past 7 days
 - d. 1 time per day
 - e. 2 times per day
 - f. 3 times per day
 - g. 4 or more times per day
- 7. During the past 7 days, how many times did you drink a can, bottle, or glass of soda or pop, such as Coke, Pepsi, or Sprite?** (Do not count diet soda or diet pop).
- a. I did not drink soda or pop during the past 7 days
 - b. 1 to 3 times during the past 7 days
 - c. 4 to 6 times during the past 7 days
 - d. 1 time per day
 - e. 2 times per day
 - f. 3 times per day
 - g. 4 or more times per day

Fruit, Vegetable, Beverages and Physical Activity Survey

8. **During the past 7 days, how many times did you drink a bottle or glass of plain water?** Count tap, bottled, and unflavored sparkling water.
- a. 1 did not drink water during the past 7 days
 - b. 1 to 3 times during the past 7 days
 - c. 4 to 6 times during the past 7 days
 - d. 1 time per day
 - e. 2 times per day
 - f. 3 times per day
 - g. 4 or more times per day

The next 3 questions ask about the physical activity you do. Physical activity can include dancing, jumping rope, walking, playing basketball, swimming, riding a bike and more. **Circle** only one answer per question. Think about each question carefully but remember **there are no right or wrong answers.**

9. **During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?** (Add up all the time you spent in any kind of physical activity that increased your heart rate and made you breathe hard some of the time.)
- a. 0 days
 - b. 1 day
 - c. 2 days
 - d. 3 days
 - e. 4 days
 - f. 5 days
 - g. 6 days
 - h. 7 days
10. **In an average week when you are in school, on how many days do you go to physical education (PE) classes?**
- a. 0 days
 - b. 1 day
 - c. 2 days
 - d. 3 days
 - e. 4 days
 - f. 5 days

Fruit, Vegetable, Beverages and Physical Activity Survey

11. In an average week how long is each of your physical education (PE) class?

- a. 15 minutes
- b. 20 minutes
- c. 25 minutes
- d. 30 minutes
- e. 30-45 minutes
- f. Greater than 45 minutes

12. During the past 12 months, on how many sports teams did you play? (Count any teams run by your school or community groups.)

- a. 0 teams
- b. 1 team
- c. 2 teams
- d. 3 or more teams

Fruit, Vegetable, Beverages and Physical Activity Survey

Demographics

How old are you? _____

Are you:

- Male
- Female

Are you Hispanic or Latino?

- Yes
- No
- Don't know/not sure
- I'd rather not say

Which one or more of the following would you say is your race? (Check all that apply)

- White
- Black or African American
- Asian
- Native Hawaiian or other Pacific islander
- American Indian or Alaska Native
- Other (please specify) _____
- Don't know/Not sure
- I'd rather not say

Name: _____

Date: _____

Thank You!

APPENDIX U

KNOWLEDGE ATTITUDE AND BEHAVIOR SURVEY WINTER AND SPRING PROGRAMS

FuelUp&Go! Knowledge, Attitudes, and Behaviors

This survey will ask you questions about your nutrition and physical activity knowledge, how you feel about certain foods and types of physical activity, and how well you understand health information. There are **no right or wrong** answers.

Answer the following statements and questions about nutrition and physical activity. Please choose only one answer per question.

Fruits and Vegetables

1. Eating fruits and vegetables protects you from diseases
 - True
 - False
2. What are the 5 food groups?
 - Protein, Fat, Grains, Dairy, Vegetables
 - Protein, Grains, Dairy, Fruits, Vegetables
 - Protein, Milk, Fat, Legumes, Grains
 - Protein, Grains, Vegetables, Fruits, Milk
3. How many servings of fruits do you think teens should eat each day to be healthy?
 - 1 serving
 - 2 servings
 - 3 servings
 - 4 servings
 - 5 or more servings
4. How many servings of vegetables do teens your age need every day to be healthy?
 - 1 serving
 - 2 servings
 - 3 servings
 - 4 servings
 - 5 servings
5. How many teaspoons of sugar does the average American consume in a day?
 - 9
 - 13
 - 17
 - 22
 - I don't know

FuelUp&Go!
Knowledge, Attitudes, and Behaviors

6. How many teaspoons of sugar equals 4 grams of sugar?
 - ¼ teaspoon
 - 1 teaspoon
 - 2 teaspoon
 - 1 tablespoon
 - I don't know

7. Which of the following counts as sugar?
 - honey
 - high fructose corn syrup
 - dextrose
 - brown rice syrup
 - all of the above

8. On average, a 20 oz. bottle of soda has how many teaspoons of sugar?
 - 1 tsp
 - 4 tsp
 - 8 tsp
 - 12 tsp
 - 16 tsp

9. How many minutes of physical activity do you think teens should get each day to be healthy?
 - At least 15 minutes each day
 - At least 30 minutes each day
 - At least 60 minutes each day
 - At least 90 minutes each day
 - I don't know

10. Why is physical activity good for teens?
 - Helps keep you from getting sick
 - Helps you pay attention in school
 - Builds healthy bones and muscles to keep you strong
 - Gives you more energy
 - All of the above

FuelUp&Go! Knowledge, Attitudes, and Behaviors

Attitudes

Now we want to know what you think about eating fruits and vegetables. There are no right or wrong answers, just your opinion. Please circle the answer that best describes how much you disagree or agree with each sentence below. Circle only one answer per row.

Fruits and Vegetables	Please choose your answer.				
11. If I eat fruits and vegetables every day I will...	I disagree very much	I disagree a little	I am not sure	I agree a little	I agree very much
become stronger	A	B	C	D	E
have stronger eyes	A	B	C	D	E
have a nicer smile	A	B	C	D	E
be healthier	A	B	C	D	E
think better in class	A	B	C	D	E
have more energy	A	B	C	D	E
My family will be proud of me	A	B	C	D	E

12. At home often do you have fruits to eat?

- Never
- Sometimes
- Always
- I don't know

13. At your home how often do you have vegetable to eat

- Never
- Sometimes
- Always
- I don't know

14. How often do your parents eat fruit?

- Never
- A few days a week
- Most days a week
- Every day
- I don't know

15. How often do your parents eat vegetables?

- Never

FuelUp&Go!
Knowledge, Attitudes, and Behaviors

- A few days a week
- Most days a week
- Every day
- I don't know

Sugar Sweetened Beverages/Water	Please choose your answer.				
16. If I drink water instead of sugar sweetened beverages I will...	I disagree very much	I disagree a little	I am not sure	I agree a little	I agree very much
become stronger	A	B	C	D	E
have a nicer smile	A	B	C	D	E
be healthier	A	B	C	D	E
think better in class	A	B	C	D	E
have more energy	A	B	C	D	E
My family will be proud of me	A	B	C	D	E

17. At your home how often do you have sugar sweetened beverages?

- Never
- Sometimes
- Always
- I don't know

18. At your home how often do you have water to drink?

- Never
- Sometimes
- Always
- I don't know

19. How often do your parents buy sugar sweetened beverages?

- Never
- A few days a week
- Most days a week
- Every day
- I don't know

20. How often do your parents drink sugar sweetened beverages?

- Never
- A few days a week

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Knowledge, Attitudes, and Behaviors

- Most days a week
 - Every day
 - I don't know
21. At school how often are sugar sweetened beverages available to purchase?
- Never
 - A few days a week
 - Most days a week
 - Every day
 - I don't know
22. At school how often is water available for you to drink?
- Never
 - A few days a week
 - Most days a week
 - Every day
 - I don't know

Physical Activity	Please choose your answer.				
	I disagree very much	I disagree a little	I am not sure	I agree a little	I agree very much
23. If I were to be physically active most days it would...					
help me be healthy	A	B	C	D	E
make me embarrassed in front of others	A	B	C	D	E
be fun	A	B	C	D	E
get or keep me in shape	A	B	C	D	E
be boring	A	B	C	D	E
make me better in sports	A	B	C	D	E

24. **At home I have sports equipment (such as balls, bicycles, skates) to use for some types of physical activity**
- Strongly disagree
 - Disagree
 - Neither agree nor disagree
 - Agree
 - Strongly agree
25. **There are playgrounds, parks, or gyms close to my home that are easy for me to get to**
- Strongly disagree

FuelUp&Go!
Knowledge, Attitudes, and Behaviors

- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree

26. I feel safe being outside and physically active in my neighborhood by myself

- Strongly disagree
- Disagree
- Neither agree nor disagree
- Agree
- Strongly agree

27. During a typical week, how often does an adult in your household...	Please choose your answer.				
	Never	1-2 times/week	3-4 times/week	1 5-6 times/week	Daily
encourage you to do physical activity?	A	B	C	D	E
do a physical activity or play sports with you?	A	B	C	D	E
provide transportation to a place where you can do physical activities or play sports?	A	B	C	D	E
watch you participate in physical activities or sports?	A	B	C	D	E

FuelUp&Go! Knowledge, Attitudes, and Behaviors

Behaviors

Now we'd like to find out how much you agree or disagree with each of the statements below. There are no right or wrong answers, just your opinion. Please circle the answer that best describes how much you disagree or agree with each sentence below. Circle only **one answer per row**.

Fruits and Vegetables	Please choose your answer.				
28. I Think I can...	I disagree very much	I disagree a little	I am not sure	I agree a little	I agree very much
write my favorite fruit or vegetable on my family's shopping list	A	B	C	D	E
ask someone in my family to buy my favorite fruit or vegetable	A	B	C	D	E
go shopping with my family for my favorite fruit or vegetable	A	B	C	D	E
pick out my favorite fruit or vegetable at the store and put it in the shopping basket	A	B	C	D	E
eat a fruit for breakfast every day	A	B	C	D	E
eat a vegetable for lunch every day	A	B	C	D	E
eat 2 or more servings of fruit or fruit juice each day	A	B	C	D	E
eat 3 or more servings of vegetables each day	A	B	C	D	E
eat 5 or more servings of fruits and vegetables each day	A	B	C	D	E

Sugar Sweetened Beverages/Water	Please choose your answer.				
29. I Think I can...	I disagree very much	I disagree a little	I am not sure	I agree a little	I agree very much
drink water instead of sugar sweetened beverages	A	B	C	D	E
drink 8 glasses of water a day	A	B	C	D	E
ask my family to drink water instead of sugar sweetened beverages	A	B	C	D	E
can explain to my family how much sugar is some common sugar sweetened beverages	A	B	C	D	E
tell a friend I don't want to drink sugar sweetened beverages	A	B	C	D	E
tell friends why I don't want to drink sugar sweetened beverages	A	B	C	D	E

FuelUp&Go!
Knowledge, Attitudes, and Behaviors

Physical Activity	Please choose your answer.				
	I disagree very much	I disagree a little	I am not sure	I agree a little	I agree very much
30. I Think I can...	A	B	C	D	E
be physically active most days after school	A	B	C	D	E
ask my parent or adult to do physically active things with me	A	B	C	D	E
ask my parent or other adult to sign me up for a sport, dance, or other physical activity	A	B	C	D	E
be physically active even if it is very hot or cold outside	A	B	C	D	E
ask my best friend to be physically active with me	A	B	C	D	E
be physically active even if I have a lot of homework	A	B	C	D	E
be physically active no matter how busy my day is	A	B	C	D	E
be physically active no matter how tired I may feel	A	B	C	D	E

Health Information

The following questions ask about health information provided in different formats.

31. How often do you need to have someone help you when you read instructions, pamphlets, or other written material from your doctor or pharmacy? **Choose only one answer.**

Never	Rarely	Sometimes	Often	Always
----- ----- ----- -----				
1	2	3	4	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

FuelUp&Go!
Knowledge, Attitudes, and Behaviors

32. How well do you understand health information in newspapers, magazines, OR in brochures in a doctor's office OR clinic? **Choose only one answer.**

Do Not Understand	Understand A Little	Understand Most of it	Understand Very Well	Understand Completely
1	2	3	4	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

33. How well do you understand health information on the Internet? **Choose only one answer.**

Do Not Understand	Understand A Little	Understand Most of it	Understand Very Well	Understand Completely
1	2	3	4	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What is your Name _____

Thanks for completing the survey!

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