AN ADOLESCENT NUTRITION LEARNING MODEL TO FACILITATE BEHAVIOR CHANGE IN A TEEN OBESITY INTERVENTION STUDY

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ABSTRACT

Adolescent obesity increases the risk for adult obesity and morbidity. Registered dietitians nutritionists (RDNs) are involved in adolescent obesity interventions intended to reverse or decrease immediate and long term complications. Qualitative methodology was used to identify perceived usefulness of RDNs to change adolescent nutrition behaviors in an obesity intervention study: Wellness Incentive to Health (WITH) program. Ten participants (adolescents between 15-17 years of age, 2 males and 8 females) were interviewed. A questionnaire guide was developed to ask participants about their knowledge of RDNs, the benefits of having RDNs in the program, and what they learned from RDNs. Participant interviews lasted approximately 30 minutes, were audio-recorded, and transcribed. Audio transcriptions were systematically coded and analyzed to identify central themes. Nine of ten participants reported little to no knowledge about RDNs *before* participating in the WITH program. Four overarching themes were identified and formed the Adolescent Nutrition Learning Model from participant responses: 1) *RDNs Provide Nutrition Information* (i.e. why and how food benefits the body, information about healthy cooking and preparation of food; and information about healthier food behaviors (i.e. portion sizes, reading labels, and recognizing satiety)*;* 2) *Adolescents Prefer Hands-On Activities* (i.e. cooking activities, tasting foods, going out to restaurants, and working in groups); 3) *Adolescents described their Change in Behavior from Concepts Learned* (i.e. learned how to eat healthy in social adolescent settings); and 4) *Adolescents disliked logging food*. Registered dietitian nutritionists in an adolescent obesity intervention program were perceived to have provided valued nutrition expertise and an Adolescent Nutrition Learning Model may be useful in guiding nutrition education for teens.

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LIST OF ABBREVIATIONS

AAP	American Academy of Pediatrics
AHA	American Heart Association
BMI	Body Mass Index
BODY	Banishing Obesity and Diabetes in Youth
CATCH	The Child and Adolescent Trial for Cardiovascular Health
CCROPP	Central California Regional Obesity Prevention Program
CDC	Centers for Disease Control and Prevention
CHILD 1	Cardiovascular Health Integrated Lifestyle Diet
CVD	Cardiovascular Disease
DASH	Dietary Approaches to Stop Hypertension
DGA	Dietary Guidelines for Americans
FNS	Food and Nutrition Services
HDL-C	High Density Lipoprotein Cholesterol
HOPS	Healthier Options for Public Schoolchildren
IRB	Institutional Review Board
LDL-C	Low Density Lipoprotein Cholesterol
MRI	Magnetic Resonance Imaging
NDC	National Dairy Council
NFL	National Football League
NHANES	National Health and Nutrition Examination Survey
PE	Physical Education
RDN	Registered Dietitian Nutritionist

SCFE	Slipped Capital Femoral Epiphysis
SDB	Sleep-Disordered Breathing
SES	Socioeconomic Status
TTM	Transtheoretical Model
TV	Television
USDA	United States Department of Agriculture
We Can!	Ways to Enhance Children's Activity and Nutrition
WITH	Wellness Incentive to Health
YMCA	Young Man's Christian Association

CHAPTER ONE

Introduction

Between1980 and 2010, the number of adolescents 12-19 years of age who were considered obese increased from 5% to 18% (Centers for Disease Control and Prevention [CDC], 2012a). Adolescent obesity has a major impact on the prevalence of adult obesity, as obesity in adolescence presents a long-term risk factor for obesity and morbidity in adulthood (Dietz, 1998; Spruijt-Metz, 2011). As a result, Surgeon General Benjamin (2010) called for health-care professionals to refocus educational and intervention strategies to help the United States reverse the current trends related to obesity. Public health clinicians, such as registered dietitian nutritionists (RDNs), serve as role models for healthy lifestyle habits and are experts in their area of health information (Benjamin, 2010). Registered dietitian nutritionists are health clinicians who are experts in the field of nutrition (Lichtenstein, 2007; Rhea & Bettles, 2012). Registered dietitian nutritionists play a vital role in promoting healthy eating habits to individuals and communities and they serve as part of the multi-disciplinary health care team.

Rationale

In the *Healthy People 2010* report, overweight and obesity was identified as 1 of 10 leading health indicators (Ogden & Carroll, 2010), which has led to a call for reduction in the percentages of children and adolescents who are classified as overweight or obese. Obesity among adults is predicted to increase by 33% over the next two decades (Finkelstein et al., 2012). According to the National Health and Nutrition Examination Survey (NHANES) nearly one-third of children and adolescents are overweight or obese (Ogden, Carroll, Kit, & Flegal, 2012). Little progress has been made toward the overall reduction in

the percentage of children and adolescents who are classified as overweight or obese (Ogden et al., 2012), however, a slight decrease of the prevalence of obesity in low-income pre-school children has been noted (Pan, Blanck, Sherry, Dalenius, & Grummer-Strawn, 2012). While many obesity interventions have been developed to target youth in improving healthy behaviors, few programs exist that specifically target teenagers struggling with obesity (Power, Bindler, Goetz, & Daratha, 2010). These programs focused on improving dietary and physical activity habits; however, the impact of these interventions has been short-term and limited in effect. Sustainability and reinforcement of healthy behaviors learned during interventions are often barriers to program success (McClaskey, 2010). While research outcomes suggest that interventions targeting school, home, and community are the most effective (McClaskey, 2010), no conclusive evidence exists about how to best implement these interventions and who should be involved in these interventions to maximize their effectiveness.

Registered dietitian nutritionists are health professionals who play a role in educating individuals about how to incorporate healthy lifestyle behaviors into their lives: determining individual energy needs, tracking energy intake and expenditure, providing tips on healthy food choices and preparation, portion sizes, etc. (American Dietetic Association, 2006a; Lichtenstein, 2007). Registered dietitian nutritionists are trained health professionals to counsel individuals to help facilitate change (Lichtenstein, 2007), and they collaborate with other health care providers to customize and emphasize healthy lifestyle behaviors to individuals during nutrition counseling sessions.

Registered dietitian nutritionists are the nutrition experts, however, self-proclaimed nutritionists present contradictory information in the media (Lichtenstein, 2007).

Consumers need assistance distinguishing the difference between accurate and evidence-based information from popular fad diets. Registered dietitian nutritionists are trained to provide evidence-based health information in the media and nutrition counseling to individuals to help prevent chronic disease (American Dietetic Association, 2006a).

Registered dietitian nutritionists have been utilized in various obesity intervention models, composing and delivering nutrition components (Collins, Warren, Neve, McCoy, & Stokes, 2007). Adolescent obesity interventions that include nutrition components with dietary modification have shown to be effective in reducing weight (Collins et al., 2007; Hollar et al., 2010). For example, a school-based obesity intervention integrated RDNs to make menu modifications to the school lunch menu and to deliver a nutrition curriculum (Hollar et al., 2010). Hollar et al. (2010) designed Healthier Options for Public Schoolchildren (HOPS) to test a school-based obesity intervention among 6- to 13-year old children over two school years. The intervention included nutrition and physical activity components with an overall goal to improve health status (reduction of Body Mass Index [BMI] percentiles and blood pressure). The nutrition component required extensive modifications to the school breakfast, lunch, and snack menus by an RDN. Modification to the menus resulted in an increased amount of high fiber items (i.e. whole grains and fresh fruits and vegetables) and a decreased number of high sugar items, as well as total fat, saturated fat and *trans* fat by reducing the number of processed food items. Registered dietitian nutritionists worked closely with the United States Department of Agriculture (USDA) Food and Nutrition Service, school administration, and cafeteria staff to ensure intervention accuracy.

In addition to menu modification, RDNs delivered school-based holistic nutrition education that emphasized a healthy lifestyle (Hollar et al., 2010). The curriculum was delivered to students, their parents, teachers, and other staff. Results of the two-year study showed significant decreases in weight and blood pressure in girls and slight decreases in weight and blood pressure in boys. These results indicate obesity interventions in schools that make menu modifications and provide nutrition and physical activity education may improve the health of school-aged children. Including school-based RDNs helped to ensure the success of the nutrition component in the intervention (Hollar et al., 2010).

In addition to school-based settings, adolescent obesity interventions take place in primary care settings or pediatric hospitals (Díaz, Esparza-Romero, Moya-Camarena, Robles-Sardín, & Valencia, 2010; Marqués, Moleres, Zapatera, Romero, & Warnberg, 2012). Registered dietitian nutritionists can provide nutrition consultations and education to adolescents and their parents to improve the successful outcomes of lifestyle changes (Díaz et al., 2010). Additionally, RDNs are the experts that can identify eating disorders among adolescents, and assess if intervention methods could risk reinforcing current eating disorders or increase adolescents' risks for developing an eating disorder (Marqués et al., 2012).

A pilot adolescent obesity intervention program called Wellness Incentive to Health (WITH) (Ramsay, Wilson, Young, & Becker, 2013) utilized RDNs to deliver a nutrition component to twenty teen participants. Improving the health and fitness of obese adolescents was the aim of the study. Registered dietitian nutritionists provided one-on-one counseling sessions to each participant to assess dietary intake, discuss individual goals, and to recommend proper intakes of carbohydrates, protein, and fat. Registered dietitian

nutritionists evaluated nutrition and activity data that participants entered into the bodybugg®, a wearable digital device accompanied by web-based tools to monitor daily calories and exercise, which was intended to aid in the individual assessments. In addition, RDNs provided six nutritional education group sessions to participants: healthy eating and goal setting, fats and fiber, fruits and vegetables, how to read a food label, hands-on healthy meal preparation techniques, and strategies for selecting healthy choices from a menu at a local restaurant. Parents and siblings were encouraged to attend educational sessions to reinforce and influence participants' health in the home environment.

As described in the previous studies, RDNs are utilized in many types of obesity interventions that target both teenage and non-teenage audiences (American Dietetic Association, 2006a). Registered dietitian nutritionists can address diet-related concerns related to various diseases such as breast cancer, (Campbell et al., 2012), diabetes (Wolf et al., 2004), and obesity (American Dietetic Association, 2006a). Wolf et al. (2004) compared the efficacy of a RDN-led lifestyle case management approach to usual medical care for obese patients with type 2 diabetes. Lifestyle case management led by an RDN improved diverse health indicators (weight, waist circumference, use of medications), and those who received usual care gained weight and required the continuation of medication. Registered dietitian nutritionists also provide nutrition education across the lifespan and act as advocates for health promotion and disease prevention in many environments (i.e. communities, organizations, etc.) (American Dietetic Association, 2006a). Registered dietitian nutritionists are valuable to any type of obesity intervention (Collins et al., 2007; Kushner & Neff, 2010) due to their expertise in nutrition and counseling skills used in obesity care and /or disease management (Kushner & Neff, 2010).

Statement of the Problem

Little progress has been made in the reduction of adolescent obesity. While adolescent obesity interventions have been reported and intervention personnel have been identified, the role of the intervention personnel and the impact they have on the adolescent obesity intervention have not been studied. Specifically, the role of registered dietitian nutritionists and adolescents' perceived benefit of having registered dietitian nutritionists involved in an adolescent obesity intervention has not been studied. Gathering data on adolescents' perceptions will aid in developing successful adolescent obesity intervention programs (Wilson, 2007). Therefore, the purpose of this study was to identify adolescents' perceptions regarding the usefulness and benefit of registered dietitian nutritionists in an adolescent obesity intervention: Wellness Incentive to Health (WITH) program.

Research Questions

Question One: What are participants' perceived benefits of having registered dietitian nutritionists involved in an adolescent obesity intervention?

Question Two: What are the participants' reported benefits of having the nutrition component as part of an adolescent obesity intervention?

Definition of Terms

Adiposity:

> The amount of fat deposit at a site or an organ in the body; an indicator of body fat status (Mahan & Escott-Stump, 2008).

Endocrine system:

> System of glands, each of which secretes different types of hormones into the bloodstream (Lobstein, Baur, & Uauy, 2004).

Frontal:

A vertical plane running from side to side that divides the body into anterior and posterior (front and back) parts. The two basic movements in the frontal plane are abduction (movement away from the body) and adduction (movement towards the body) parallel to the frontal plane) (Oatis, 1988).

Hyperglycemia:

High blood sugar. An elevated level specifically of the sugar glucose in the blood, often seen in diabetes (Mahan & Escott-Stump, 2008).

Hyperlipidemia:

Hyperlipidemia is a condition where there is an elevation of lipids, or fats, in the blood and may lead to heart disease (Mahan & Escott-Stump, 2008).

Hypertension:

High blood pressure. The American Heart Association (AHA) defines hypertension as blood pressure of 140 over 90 or higher (American Heart Association, 2013).

Individual factors influence obesity:

Influences include lifestyle factors such as food preferences, knowledge of healthy eating, time and convenience, dieting behaviors, physical activity (or lack thereof) (Story, Neumark-Sztainer, & French, 2002).

Insulin resistance:

The diminished ability of cells to respond to the action of insulin in transporting glucose(sugar) from the bloodstream into muscle and other tissues, or excess insulin secretion by the body in an attempt to regulate blood sugar (Mahan & Escott-Stump, 2008).

Macrosystem:

This is the influence of the larger society that affects adolescents' eating behaviors: media, cultural and social norms, and food production and distribution systems (Story et al., 2002).

Metabolic syndrome:

The name for a group of risk factors that occur together and increase the risk for coronary artery disease, stroke, and type 2 diabetes (Grundy, Brewer, Cleeman, Smith, & Lenfant, 2004).

Morbidity**:**

A diseased condition or state or the incidence or prevalence of a disease or of all diseases in a population (Merriam-Webster, Incorporated, 2013).

Nephropathy:

Disease of the kidneys caused by damage to the small blood vessels or to the units in the kidneys that clean the blood. Often occurs as a result and untreated diabetes (Mahan & Escott-Stump, 2008).

Neuropathy:

Nerve damage that can occur as a result of uncontrolled diabetes. Neuropathy can range from pain and numbness in extremities to problems with the digestive system, urinary tract, blood vessels and heart (Mahan & Escott-Stump, 2008).

Physical environment influences obesity:

Influences that affect adolescents' eating behaviors are community settings such as schools, fast-food restaurants, convenience stores, worksites, and vending machines (Story et al., 2002).

Retinopathy:

Complication of diabetes that affects the eyes caused by damage to the blood vessels of the light-sensitive tissue at the back of the eye (retina) (Mahan & Escott-Stump, 2008).

Sagittal:

A vertical plane running from front to back that divides the body into left and right sides. The two basic movements in the sagittal plane are flexing and extending (Oatis, 1988).

Screen time**:**

Time spent viewing TV/video, computer, electronic games, hand-held devices or other visual devices (Foltz et al., 2011).

Slipped capital femoral epiphysis (SCFE):

A debilitating condition which involves displacement of the bones at and around the hip joint; commonly associated with obesity or excessive exercise (Wabitsch et al., 2012).

Social environment influences obesity:

Influences include family behaviors, socioeconomic status (SES), and peer impact on eating behaviors (Story et al., 2002).

Delimitations and Limitations

This study is not without delimitations. First, a small convenience sample composed of adolescents from one high school in one geographical area and who were primarily Caucasian, participated in the study. Selection of this sample was to determine adolescents' perceptions regarding the benefits of RDNs in a specific adolescent obesity intervention, the

WITH program. Participants' attendance in the nutrition component varied; however, all participants attended a minimum of six activities in the WITH program. Another delimitation is participants met the inclusion criteria of the WITH program: 85th percentile or above for BMI-for-age and were 15 to 17 years of age during participation in the WITH program. Adolescents were not re-measured for BMI because this was not the focus of this study.

One limitation is the participant sample did not have equal representation of males and females, but previous research has shown females to have higher participation rates in childhood and adolescent obesity interventions (Moore et al., 2009; Porter & Pelletier, 2012; Robbins, Pfeiffer, Maier, Lo, & Wesolek Ladrig, 2012; Stice, Shaw, & Marti, 2006) which is consistent with the current study. Further, this study targeted adolescents from a specific adolescent obesity intervention so a limitation is present that the results of this study are not generalizable. Adolescents who participated in other obesity programs may have different perceptions of RDNs and/or nutrition components in those programs.

The Research and Researcher

The researcher in qualitative research is seen as the key tool of data collection (Draper & Swift, 2010); the researcher should acknowledge his or her role in the research and recognize potential bias. Draper and Swift (2010) recommended researchers select data collection and sampling techniques carefully to ensure high-quality research. Research methods should be designed based on the researcher's philosophical views: (1) how his or her professional position may impact how the data is analyzed, (2) take an objective or subjective stance, and (3) choose methodology that best fits the overall research question.

As a qualitative researcher, my profession as an RDN impacts how I analyzed data in this study. I have a passion for helping others with the aim for making an impact on their well-being. As an RDN, I enjoy sharing my knowledge about nutrition and healthy eating habits with others to influence their habits. With childhood and adolescent obesity being a major public health concern, I am eager to make an impact in this population by sharing strategies for a healthier life. My interest in the adolescent population became increasingly apparent when I was one of the RDNs that designed and delivered the nutrition component in a recent adolescent obesity intervention: WITH program. My role as an RDN in an adolescent obesity intervention impacted the way I analyzes the current data so that I can better understand what RDNs need to do to provide effective nutrition education to teenagers resulting in healthy behavior changes. Further, I can share results with other RDNs and nutrition educators about how adolescents perceive RDNs and their role in an intervention so future nutrition components can be tailored to their needs.

As a qualitative researcher, it is crucial for me to take a subjective stance when collecting data. The aim of this study was to identify adolescents' perceptions of RDNs and the nutrition component in an adolescent obesity intervention: WITH program. It was imperative to acknowledge that each participant may have differing views of the same RDNs and nutrition component. Assuming a subjective stance provides accurate results by considering the true views of the adolescents as opposed to the researcher letting his or her own views and values influence the results (Draper & Swift, 2010).

The research questions were open-ended questions seeking perceptions of the adolescents who participated in the WITH program. I felt the appropriate tool to gather this data was the use of an interview guide developed and reviewed by a childhood obesity

expert. Although interview questions were in a structured format, interviews with participants were unstructured, with open-ended questions that allow for prompts and probes. This allowed for interviews to capture personal experiences of the adolescents as they related to RDNs and the nutrition component in an adolescent obesity intervention (Willig, 2008).

In summary, the purpose of this study was to identify adolescents' perceptions regarding the usefulness and benefit of RDNs in an adolescent obesity intervention: Wellness Incentive to Health (WITH) program. The results of this study may be beneficial in the treatment and prevention of adolescent obesity. In addition, other RDNs and health care professionals may consider the adolescents' perceptions when designing and delivering nutrition components in adolescent obesity interventions.

Summary

Chapter one provided an overview of adolescent obesity interventions and the role of the RDN. Research questions were outlined, relevant terms were defined. Further, delimitations and limitations of the study were stated, as was the role of the researcher. The second chapter will provide a review of the literature related to the prevalence of adolescent obesity, short-term and long-term health consequences of adolescent obesity, factors that influence adolescent obesity, types of adolescent obesity interventions that currently exist, and the role of the RDN in adolescent obesity interventions. Chapter three is written in manuscript style and will include an introduction, methodology, results, conclusions, and implications for future practice in adolescent obesity interventions regarding the usefulness of registered dietitian nutritionists. As it is written in manuscript form, some information from Chapters one and two will be repeated.

CHAPTER TWO

Review of Literature

The purpose of this study was to determine adolescents' perceptions regarding the usefulness of registered dietitian nutritionists in an adolescent obesity intervention: Wellness Incentive to Health (WITH) program. Adolescent obesity has a major impact on the prevalence of adult obesity, as obesity in adolescence presents a long-term risk factor for obesity and morbidity in adulthood (Dietz, 1998; Spruijt-Metz, 2011). Targeting obese teens with appropriate intervention methods and personnel may help to reverse these trends, but much research is needed to determine the best methods and personnel to deliver adolescent obesity interventions (Spruijt-Metz, 2011; Stice et al., 2006). This review of literature begins by discussing the impact of adolescent obesity on the health of adolescents. The next section examines the rise in health care costs as it relates to adolescent obesity followed by how adolescent obesity is defined. Numerous factors influence adolescent obesity which will then be discussed in the fourth section: lifestyle/individual, social environment, physical environment, and the macrosystem. The final topic discusses adolescent obesity interventions, identifying types, successful characteristics, and guidelines for conducting an obesity intervention. The chapter will end by presenting the role RDNs play in adolescent obesity interventions.

Health Consequences of Adolescent Obesity

Obesity has immediate and long-term consequences on the health and quality of life of adolescents (Ortega, Ruiz, Castillo, & Sjöström, 2008; Rosnov et al., 2011; Schwimmer, Burwinkle, & Varni, 2003). Obese children and adolescents are more likely to experience immediate health consequences such as an increase in psychosocial problems such as

depression, poor self-image, and low self-esteem as well as physical health complications such as insulin resistance, joint problems, and breathing disorders (Daniels et al., 2005; Lobstein et al., 2004; Sharma, 2006). Obese children also are more likely to experience long term health consequences that include an increased likelihood of medical complications in the future (Dietz, 1998). Children who are overweight or obese in childhood are more likely to become obese adults (Dietz, 1998; Reilly et al., 2003). Obese adults have an increased risk of cardiovascular disease (CVD), type 2 diabetes mellitus, metabolic syndrome, and certain types of cancers (Daniels et al., 2005), as well as an increased risk of adult morbidity and premature mortality (Reilly & Kelly, 2011).

Short-term impact of adolescent obesity. Overweight and obese adolescents experience negative health effects similar to overweight and obese adults (Daniels et al., 2005). Since the 1980s and 1990s, type 2 diabetes and cardiovascular risk factors in youth, which were once considered rare in adolescents, have been increasing (Daniels et al., 2005; Lobstein et al., 2004). Additionally, metabolic syndrome is more common in children and adolescents than previously reported, with a higher Body Mass Index (BMI) associated with an increased risk of the condition (Weiss et al., 2004). Obesity in the pediatric population is also associated with breathing problems such as sleep apnea and asthma, physical discomfort such as musculoskeletal pain and joint problems, and psychosocial distress, which includes low self-esteem and depression (Dietz, 1998; Han, Lawlor, & Kimm, 2010; Papoutsakis et al., 2013; Sutherland, 2008; Taylor et al., 2006). Each of the conditions will be discussed.

Short-term impact on type 2 diabetes. The prevalence of type 2 diabetes is increasing in children and adolescents while the age of onset of type 2 diabetes in adults is

falling (Shaw, 2007). Obese youth are twice as likely to be diagnosed with type 2 diabetes than those who are of normal weight (Clemens & Bidlack, 2009). Childhood obesity can lead to the development of type 2 diabetes due to the effects of an inflammatory state (DeBoer, 2013) combined with excess visceral adipose tissue that may have a role in the development of insulin resistance. Children and adolescents diagnosed with type 2 diabetes tend to be between 10 and 19 years old, obese, have a strong family history for type 2 diabetes, and have insulin resistance (Centers for Disease Control and Prevention [CDC], 2012b). Type 2 diabetes in youth may go undiagnosed for a long time because it is difficult to identify type 2 diabetes in this population (CDC, 2012b). Children may have mild or no symptoms and blood tests are needed for diagnosis. Due to the difficulty of diagnosing type 2 diabetes in children and adolescents, the magnitude of type 2 diabetes among this population is most likely underestimated (CDC, 2012b).

Type 2 diabetes, if not properly treated, can lead to debilitating consequences such as neuropathy, retinopathy, nephropathy, and CVD (Mahan & Escott-Stump, 2008). According to the American Diabetes Association (2012), children and adolescents with type 2 diabetes already show signs of complications, including an earlier onset for CVD.

Short-term impact on cardiovascular disease. Obesity in youth is a critical public health problem that may lead to cardiovascular problems resulting in youth having a shorter life expectancy than their parents (Daniels et al., 2005). In the Banishing Obesity and Diabetes in Youth (BODY) Project (Sweat et al., 2012) that took place in a New York City public high school, 51% of the student body was overweight or obese after BMI was assessed. The BODY Project is a school-based intervention that medically screens high school students who are overweight and obese. Eighty-two percent were found to have

unhealthy ranges in at least one category of the complete medical evaluation (i.e. survey, blood pressure, and blood tests). Once results of the screenings were analyzed, personalized feedback was provided and referrals were made to the appropriate health clinician. Adolescents are not routinely screened for diabetes and CVD (Sweat et al., 2012), therefore the BODY Project was designed to allow students to gain access to their personal medical information and inform them of a plan for positive lifestyle changes.

May, Kuklina, and Yoon (2012) examined selected biological CVD risk factors in overweight and obese adolescents. Prehypertension/hypertension and abnormal biomarker low density lipoprotein cholesterol (LDL-C) accounted for the majority of CVD risk factors (i.e. prediabetes/diabetes, low biomarker high density lipoprotein cholesterol [HDL-C], etc.) among this population, indicating that overweight and obese adolescents are at an increased risk for CVD (May et al., 2012). Adolescent obesity is associated with the decline of cardiovascular health, an immediate risk factor for future cardiovascular morbidity and mortality (Raj, 2012).

Short-term impact on metabolic syndrome. Diagnosis of metabolic syndrome has increased in adolescents who are obese (Grundy et al., 2004). Metabolic syndrome is a cluster of conditions such as hyperglycemia, obesity, hypertension, and hyperlipidemia. Weiss et al., (2004) found an increase in BMI was associated with an increased risk of metabolic syndrome among overweight children and adolescents. Metabolic syndrome is thought to be caused by a combination of genetic and environmental factors such as excess calorie intake and reduced physical activity, but the most influential risk factor is the rate of increase in BMI in youth (Daniels et al., 2005). The presence of metabolic syndrome poses an increased risk for both type 2 diabetes and CVD (Clemens & Bidlack, 2009).

Short-term impact on breathing problems. Disordered breathing during sleep is an obesity-related health condition once thought only applicable to adults; is more frequently identified in obese children (Daniels, 2006; Verhulst et al., 2007). Sleep apnea is a condition of sleep-disordered breathing (SDB), that is associated with obesity in children, and it has shown to promote insulin resistance (Raj & Kumar, 2010). In addition, sleep apnea poses a risk for CVD. Both obstructive sleep apnea and central sleep apnea were found in obese and overweight youth. Obesity and adipose tissue are correlated with central sleep apnea, which reflects an unstable breathing pattern.

Another common breathing disorder related to obesity is asthma (Sin & Sutherland, 2008). Asthma is a common respiratory disease found in children in which the airways of the lungs are constricted (Daniels, 2006). Originally, this condition was thought to be brought on by allergies; however, more information is needed to learn about environmental factors that trigger asthma. What should not be ignored is the prevalence and severity of asthma increased in the past two decades, a parallel with the increasing prevalence of childhood and adolescent obesity (Daniels, 2006). While there is no clear link in the pathophysiology of asthma as a result of obesity, it is thought that chronic systemic inflammation due to high BMI may worsen inflammation in the airways and lead to asthma (Khan, Rastogi, Isasi, & Coupey, 2012; Papoutsakis et al., 2013; Sutherland, 2008). Recent data has brought attention to the association of obesity and asthma, but more investigation is needed (Sutherland, 2008).

Short-term impact on physical consequences. Obesity places stress on the body and various joints, specifically the back and joints of the lower extremity (Stovitz, Pardee, Vazquez, Duval, & Schwimmer, 2008). In a study conducted by Stovitz et al. (2008), 61%

of subjects, who were obese, reported musculoskeletal pain in at least one joint, most commonly in the back, feet, and knees. Higher bodyweight and BMI were associated to hip pain as well. Slipped capital femoral epiphysis (SCFE) normally occurs at the time of a growth spurt in growing children and is associated with the increased incidence of obesity or even excessive physical activity (Wabitsch et al., 2012). Slipped capital femoral epiphysis is a debilitating condition which involves displacement of the bones at and around the hip joint. Slipped capital femoral epiphysis will exhibit pain in the hip and thigh area. Morbidly obese children and adolescents, who suffer from knee pain, showed transformational changes in cartilages through the use of high-resolution magnetic resonance imaging (MRI) (Widhalm et al., 2012). Furthermore, the percentage of cartilage lesions was associated to the degree of obesity. Cartilage and meniscus defects can be associated with reduced knee range of motion and even physical disability. Movement differences in both sagittal and frontal of the lower extremity during walking were dramatic between obese and healthy weight adolescents (McMillan, Pulver, Collier, & Williams, 2010), showing atypical patterns in obese subjects. Sagittal and frontal are defined as planes of motion of the body (Oatis, 1988). Movement in a plane is perpendicular to its axis. The sagittal plane divides the body in left and right sides. Hence sagittal movements are flexion and extension (moving body parts front and back). The frontal plane divides the body into front and back sides. Therefore, frontal movements include abduction and adduction (moving body parts sideways - away or toward the body). Long term consequences of atypical movements have not been investigated. However, abnormalities in movements raise concerns about the structural integrity of the lower extremity joints over a period of time. Adolescents who are obese are encouraged to walk every day to increase their

physical activity (McMillan et al., 2010). It is important to understand the mechanisms behind physical abnormalities in obese adolescents so that the mechanisms of abnormalities can be addressed clinically. Because musculoskeletal pain is associated with adolescent obesity (Stovitz et al., 2008), clinicians must be cognizant of the effects when making recommendations for physical activity for treating obesity. Recommended activities should be those that will not place stress on the frontal and sagittal joints such as swimming or cycling which could alleviate the amount of weight placed on the joints of the lower extremity (Stovitz et al., 2008; Taylor et al., 2006). Furthermore, clinicians treating obese adolescents with musculoskeletal pain may promote weight loss as a possible treatment (Stovitz et al., 2008).

Short-term impact on psychosocial consequences. Obese adolescents are perceived by their peers as self-indulgent, lazy, and grossly rotund (Robinson, 2006). Negative social perceptions place obese adolescents at risk for teasing, bullying, and social isolation by their peers, which has immediate negative effects on the psychosocial development of youth that could last into adulthood (Daniels et al., 2005; Dietz, 1998; Robinson, 2006). A sample of licensed school nurses from 21 Minnesota school districts were interviewed regarding their beliefs and opinions about childhood obesity (Morrison-Sandberg, Kubik, & Johnson, 2011). Participants believed that weight-related teasing was very common and they recognized that obesity placed stress on adolescents' body image and mental health. Risk for social anxiety is increased in obese adolescents as a result of peer victimization (Jelalian, Sato, & Hart, 2011). The psychosocial distress obesity places on one's life can significantly reduce quality of life (Schwimmer et al., 2003). According to Schwimmer et al. (2003),

childhood and adolescent obesity is one of the least socially acceptable and most stigmatizing conditions.

Among the psychosocial health issues related to adolescent obesity is a negative body image (Daniels, 2006). More obese females than males tend to have higher dissatisfaction with their bodies (Chaiton et al., 2009; Daniels, 2006); however, obese males are not exempt from negative body images. Females expressed feeling depressed due to the societal and cultural pressure to be thin, whereas males may have societal pressure to gain muscle mass (Chaiton et al., 2009).

Adolescent obesity interventions should consider addressing both negative body image and the pressure to be thin to help reduce depressive symptoms and improve mental health among overweight and obese adolescents (Chaiton et al., 2009). Additionally, to protect overweight and obese adolescents from psychosocial problems, counselors, school psychologists, and educators must be aware of weight-based bullying or teasing (Puhl, Luedicke, & Heuer, 2011).

Long-term impact of adolescent obesity. Negative health conditions in obese children and adolescents will persist into adulthood if obesity is not reversed (Daniels et al., 2005; Reilly & Kelly, 2011). The long term negative health consequences are similar to the short-term health consequences to include: increased risk for type 2 diabetes and its associated diseases, CVD, cancer, and physical consequences (i.e. hip osteoarthritis). However, childhood overweight or obesity increases the risk for their development in adulthood, even when these diseases do not fully present themselves in childhood (Daniels, 2006). Adolescents who are persistently overweight, starting with a high BMI in high

school, are more likely to be diagnosed with a chronic health problem by age forty (Clarke, O'Malley, Schulenberg, & Johnston, 2010).

Long-term impact on type 2 diabetes. The progression of type 2 diabetes is related to obesity (Ali et al., 2011), with increased visceral fat area correlating with pre-diabetic impaired glucose tolerance and insulin resistance. Reducing body weight and increasing physical activity should be the initial attempt to avoid the development of type 2 diabetes from a pre-diabetic state (Stoeckli & Keller, 2004). If type 2 diabetes is not address or diagnosed in childhood, then the risk factors continue into adulthood and present long term risk for developing the disease in adulthood (Clemens & Bidlack, 2009; Daniels, 2006; Shiasi-Arani, Ghasemi, Moravveji, & Shahpouri-Arani, 2012). Type 2 diabetes, whether diagnosed in childhood or adulthood and left untreated or unmanaged, can lead to other chronic diseases such as heart disease, stroke, nephropathy, retinopathy, and neuropathy (Mahan & Escott-Stump, 2008; Tascilar et al., 2011).

Long-term impact on cardiovascular disease. Cardiovascular disease is the leading cause of adult death (Schafer & Ferraro, 2012), and it is linked to obesity. The increase in relative adiposity from childhood to adulthood may increase the risk for detrimental health effects in adulthood (Lloyd, Langley-Evans, & McMullen, 2010). The prevalence of high blood pressure and high cholesterol in obese children and adolescents leads to the hardening of the arteries and can ultimately lead to a heart attack or stroke in adulthood (Daniels, 2006). Being overweight or obese in childhood can accelerate the onset of heart disease from later adulthood to early adulthood as well as other chronic diseases and may reverse life expectancy (Daniels, 2006).

Long-term impact on cancer. Cancer is second to CVD in adult mortality (Schafer & Ferraro, 2012). Gallbladder, liver, pancreatic, colorectal, prostate, kidney, and breast in women are types of cancers correlated with obesity (Stoeckli & Keller, 2004). Epidemiological studies have identified biomarkers in obese individuals that are associated with certain types of cancer such as increased blood levels of insulin and inflammatory markers (Chen, 2011). Not only do obese adults have an increased risk for developing many types of cancers, but the excess weight and insufficient physical activity may negatively affect cancer prognosis, treatment, and the quality of life among adult cancer survivors (Eheman et al., 2012). The state of obesity disturbs metabolic processes, that affects multiple hormones, growth factors, and other mediators in the body (Hursting & Dunlap, 2012), all of which may place emphasis on growth signaling, inflammation, and vascular distress linked to the susceptibility of cancer.

One type of cancer associated with obesity is breast cancer (Kaklamani et al., 2011; Pfeiler et al., 2009; Ray, 2012). Breast cancer is the leading cause of cancer death in women worldwide, and it is one of the most common cancers (Ray, 2012) having been linked to menstrual abnormalities in girls (Lobstein et al., 2004). Abnormalities and early onset of menstruation is in response to the disturbance of the endocrine system (system of glands, each of which secretes different types of hormones directly into the bloodstream). Early onset of menstruation is a risk factor for developing breast cancer in adulthood and has been linked to other cancers of the female reproductive system (Breast Cancer Fund, n.d.).

Estrogen is the hormone associated with the pathological process of breast cancer (Pfeiler et al., 2009; Ray, 2012). Increased exposure to estrogen as a result of early onset of menstruation raises a girl's risk for breast cancer later in life (Breast Cancer Fund, n.d.). In

addition, adipose tissue is the major source for estrogen (Ray, 2012), therefore increased levels of estrogen present in a girl and/or woman may be due to the amount of adipose tissue she carries.

Obesity is also linked to gastrointestinal cancers (i.e. esophageal, pancreatic, colorectal, and kidney cancer) (Donohoe, Pidgeon, Lysaght, & Reynolds, 2010), which may be due to the negative effect adipose tissue has on the endocrine system and metabolic pathways. Excess adipose tissue in obese individuals releases growth hormones and causes chronic inflammation, that may explain the link between obesity and gastrointestinal cancers (Zeng & Lazarova, 2012). Insulin resistance found in many obese subjects may promote cell proliferation in colon cancer due to the increased expression of insulin receptors in the colon (Donohoe et al., 2010; Zeng & Lazarova, 2012).

Maintaining a healthy diet and sufficient physical activity to reduce excess weight may protect against cancer (Eheman et al., 2012). The number of obesity related cancers may be reduced by health behavior changes that help reduce weight (Vucenik & Stains, 2012).

Long-term impact on physical consequences. Physical consequences of obesity in adulthood are commonly preceded by musculoskeletal abnormalities in early childhood, which may explain the increase in hip osteoarthritis in adults who were obese as children (Wabitsch et al., 2012). The constant wear and tear on joints in obese adolescents will become problematic in adulthood, even if mild abnormalities occurred early in life. When SCFE and other musculoskeletal abnormalities are present in obese children and adolescents, follow-up with these patients is necessary in order to help alleviate physical problems in adulthood (Wabitsch et al., 2012). However, more research is needed to

determine if the risk of osteoarthritis in adulthood can be reversed or reduced after significant weight loss in youth (Widhalm et al., 2012).

Childhood and adolescent obesity has substantial short-term negative effects on the health of children and adolescents such has CVD, type 2 diabetes, metabolic syndrome, physical, and psychosocial problems (Reilly & Kelly, 2011; Reilly et al., 2003; Schwimmer et al., 2003). These same health consequences are evident in long-term as well as cancer (Reilly et al., 2003). To alleviate the health consequences of obesity in adulthood, developing childhood and adolescent obesity interventions to prevent and treat obesity in youth is merited.

Health Care Costs Associated with Adolescent Obesity

Health care costs have risen in response to the associated health problems with the obesity epidemic (Daniels, 2006). Obesity is associated with higher risks of cardiovascular and other chronic diseases, which have led to the necessity of complex medical innovations to treat the disease. The increased use of these complex medical innovations in response to the rise in obesity, has been identified as the primary factor in the increase of health care spending (Thorpe, 2006). Diabetes, hyperlipidemia, and heart disease has accounted for 22% of the overall rise in spending, all of which are attributed to obesity (Thorpe, Florence, Howard, & Joski, 2004). Obese individuals have medical costs approximately 30% greater than normal weight individuals (Withrow & Alter, 2011).

Obesity-related health care costs may begin in childhood and persist into adulthood (Daniels, 2006). As type 2 diabetes, cardiovascular disease, and metabolic syndrome become more prevalent in obese adolescents, health care costs associated to treating these diseases rise (Lobstein et al., 2004). The direct medical costs for treating obesity-related

diseases has increased as well as indirect costs such as lost days of employment by an adolescent or by a parent/guardian if the adolescent requires medical attention.

Wang and Dietz (2002) studied the economic burden of obesity in youth aged 6 to 17 years. The percentage of hospital discharges associated to obesity-related diseases increased dramatically from 1979 to 1999. The number of discharges of diabetes nearly doubled. Annual hospital costs related to obesity-associated diseases have increased from $35 million to $127 million. As the prevalence of childhood and adolescent obesity continues to be a concern, health care costs associated with obesity-related diseases are likely to rise (Wang & Dietz, 2002).

A significant financial burden on national health care will ensue as a result of adolescent obesity and the early onset of disease, which will lead to a longer lifetime of disability and treatment (Lobstein et al., 2004). Better knowledge of health care costs related to childhood and adolescent obesity can help the health care system determine the best approach for treating and preventing childhood and adolescent obesity (Daniels, 2006).

How Adolescent Obesity is Defined: BMI

Body mass index, which is calculated by dividing weight in kilograms by height in meters squared (kg/m^2), is used to categorize overweight and obesity in adults as well as children and adolescents (Ogden & Carroll, 2010). Obesity in children and adolescents is determined by using BMI-for-age-growth charts through the 2000 Centers for Disease Control and Prevention (CDC) (Ogden & Carroll, 2010). Current recommendations from an expert committee identified children and adolescents (ages 2 – 19) obese if their BMI values were at or above the 95^{th} percentile of gender-specific BMI growth charts. Overweight is classified as $\geq$ the 85^{th} percentile (Ogden & Carroll, 2010). Body mass index is not used as

a diagnosis, rather an indicator of risk for future health problems or the risk for the development of diseases (Ogden & Carroll, 2010).

Factors that Influence Adolescent Obesity

Adolescent obesity is a public health concern that must address all influential factors (Storey, Forshee, Weaver, & Sansalone, 2003). To help understand the factors that influence adolescent obesity, it's important to look at four levels of influence: lifestyle/individual factors, social environment, physical environment, and the macrosystem (Story et al., 2002). Lifestyle/individual influences include psychosocial and lifestyle factors such as food preferences, knowledge of healthy eating, time and convenience, and dieting behaviors. The social environment includes family behaviors and socioeconomic status (SES) on eating behaviors. Physical environments that affect adolescents' eating behaviors are the community settings such as schools, fast-food restaurants, convenience stores, worksites, and vending machines. The macrosystem is the influence of the larger society that affects adolescent eating behaviors: media, cultural and social norms, and food production and distribution systems. The following paragraphs will expand on each of the influential factors.

Lifestyle/individual influences on adolescent obesity. While demographic factors such as age, gender, and ethnicity cannot be changed, lifestyle factors can be modified (i.e. attitudes towards healthy eating, dietary habits, and physical activity (Spruijt-Metz, 2011). Each of the factors will be discussed.

Attitudes and behaviors. Recognizing teenagers' attitudes and behaviors that affect food intake and weight is important in order to try to understand the root cause of overeating or disordered eating (Pretlow, 2011). Pretlow (2011) conducted a ten-year study that

analyzed (both quantitatively and qualitatively) anonymous posts, chat room transcripts, and poll responses of adolescents. This interactive, open access website revealed root factors for adolescents who were struggling with weight loss. Attitudes such as boredom, stress, and depression appeared to spark addictive characteristics with comfort food and overeating in participants: "I eat cause I am depressed and bored most of the time" (as quoted in Pretlow, 2011, p. 299); "I was stressing out big time about my exams. . . I had the biggest binge ever" (as quoted in Pretlow, 2011, p. 298).

Addictive characteristics to food are described as having a dependence on highly pleasurable foods or food substances, and can be compared and contrasted to that of drug addiction (Volkow & Wang, 2005). Drugs offer pleasure through direct pharmacological effects, whereas certain foods (which vary in individuals) may provide pleasure by fast sensory signals, and can slow certain process such as the increase in brain glucose. Adolescents' responses demonstrated an addiction to food: "It's like a drug. What used to satisfy you before now has no effect. I feel like I've become immune to the foods that used to comfort me . . ." (as quoted in Pretlow, 2011, p. 300); "I think I'm ADDICTED to FOOD. . . I TRY to eat RIGHT until I eat stuff that TASTES GOOD! . . . I try to TALK myself OUT of OVEReating but it doesn't work" (as quoted in Pretlow, 2011, p. 302). Acknowledging that food can be perceived as an addictive substance for adolescents may provide an important factor to consider in intervention and prevention programs (Pretlow, 2011).

Behaviors such as cigarette and alcohol use of adolescents have a negative effect on eating patterns and physical activity (Jasuja, Chou, Riggs, & Pentz, 2008). Smoking may negatively affect food choice and meal patterns, resulting in a lower intake of healthy foods

(fruits, vegetables, grains, etc.) and a higher intake of processed and fatty foods (Sjöberg, Hallberg, Höglund, & Hulthén, 2003).

Adolescents have sporadic eating patterns that must be addressed to meet their needs (Sjöberg et al., 2003). Adolescents have greater nutrient and energy needs than the adult population due to their demanding needs during growth patterns; however, irregular meal patterns lead to poor nutrient intake due to unhealthy food choices (Sjöberg et al., 2003). Sjöberg et al. (2003) found that skipping breakfast and/or lunch led to the poorest nutrient intake because of less healthy food choices that occurred later in the day. These lifestyle habits could continue into adulthood (Sjöberg et al., 2003).

Merten, Williams, and Shriver (2009) studied adolescents' and young adults' breakfast consumption patterns and obesity status. Participants were selected from the National Longitudinal Study of Adolescent Health (20,745 subjects, ages 11 to 18 years). A total of 7,788 participants were studied and data was collected in three waves: Wave 1 (September 1994 to April 1995), Wave 2 (April 1996 to August 1996), and Wave 3 (August 2001 to April 2002). The researchers also looked at 12 to 19 year-old adolescents during Wave 2 and 18 to 26 year-old young adults during Wave 3. Results indicated that community and parental factors influenced the consumption of breakfast (i.e. teenagers were more likely to eat breakfast when their parents were home in the morning). Adolescents who consumed breakfast regularly tended to maintain that pattern through young adulthood, and were at less risk for chronic obesity than those who skipped it (Merten et al., 2009).

Lack of physical activity and increased screen time. In addition to eating behaviors, physical activity or the lack thereof, directly influences health and weight maintenance in adolescents (Casazza & Ciccazzo, 2007). Technological advances have made it convenient

for youth to be sedentary, and it has displaced physical activity. Adolescents who spent the most amount of time watching television (TV) and spending time on the internet tended to have higher BMIs (Yen et al., 2010). Overweight and obese adolescents tend to be more sedentary, engaging in at least two hours per day of screen time (TV, internet, and video games) and only fifteen minutes of physical activity (Pedrosa et al., 2011). In addition, adolescents tend to snack while using media, leading to excessive energy intake of unhealthy food choices (Kaiser Family Foundation, 2004).

Social environment influences adolescent obesity. Two main social influences on adolescent obesity include family and low SES. Family influences adolescents' eating behaviors in two ways: 1) family is the primary source of healthy food choices and 2) family influences adolescents' attitudes and values that affect eating habits (Story et al., 2002). Low SES affects families' access to provide a consistent source of healthy food choices (Cowell, 2011). These influences are discussed in the following text.

Family influences adolescent obesity. Family plays a role in adolescents' eating behaviors (Story et al., 2002). Not only is the family the provider of food, but family acts as a model for food attitudes and preferences that will affect long-term dietary behaviors in youth. When one or both parents are present, adolescents tend to eat breakfast compared to adolescents that don't have a parent present (Merten et al., 2009). In a 5-year longitudinal study (Burgess-Champoux, Larson, Neumark-Sztainer, Hannan, & Story, 2009) adolescents whose families had regular family meals had enhanced overall diet quality, reported more healthful diets, and had more consistent meal patterns than those that did not. Parents may have little control over what their children eat outside the home, but they can influence

choices inside the home by making healthy food choices available and accessible (Story et al., 2002).

Low socioeconomic status influences adolescent obesity. While obesity affects adolescents without regard to gender, race, and SES, low SES does raise the risk for obesity (Cowell, 2011). Mothers with a low income status and who were less acculturated reported the weight status of their children to be higher (BMI in the overweight or obese range) than mothers with a higher income and who were more acculturated (Tyler, 2004). Low SES places barriers and challenges for improving health (Wang et al., 2006). The reasons may be due to parents' concerns for their children's safety playing outside, therefore encouraging television viewing and the use of video games to entertain children. In addition, people in lower income communities often do not have access to fresh fruits and vegetables or lower fat options (Wang et al., 2006). Various reasons exist for the lack of access: no vehicle, distance to a market, and travel time to a larger supermarket (Ver Ploeg et al., 2009). Lower SES communities have easier access to convenient stores, which predominantly sell canned fruits and vegetables that can often be high in sugar and salt respectively. Neighborhoods of lower SES had 1.25-1.3 times the number of fast food restaurants compared to higher income neighborhoods (Powell, Han, & Chaloupka, 2010), making access to less healthier options for low income families easier than healthier options (Ver Ploeg et al., 2009). In addition, price gaps between healthy and unhealthy foods have increased, with healthy foods more expensive than unhealthy foods (Powell et al., 2010). Powell et al., 2010, found that prices for meat, fruits and vegetables, grains, and dairy products remained level from 1990 to 2007 while the prices of fast food fell by 12% and prices of sodas fell by 32%, making it easier and more affordable to purchase less healthy foods.

Public policy may have a role in making changes in these environments by providing pricing interventions such as taxes on less healthy foods, subsidies for fruits and vegetables, and tax breaks for supermarkets to locate in lower SES communities (Powell et al., 2010). For instance, it was found that a 10% increase in fast food prices was correlated to a 1% decrease in adolescents' BMIs (Powell, 2009). The increased acceptance of food stamps at farmers markets is an excellent way to increase access to fruits and vegetables at a subsidized cost (Powell et al., 2010). Results from policy change can further the understanding of how pricing and accessibility of healthier options have on food choices and BMI among children and adolescents.

Physical environment influences adolescent obesity. Adolescents spend a large portion of their time away from the home environment such as at school, a part-time job, or engaging in activities with friends (Story et al., 2002). Because of this, adolescents often eat in environments other than the home, which influence their access and choices of foods (Story et al., 2002). Physical environments that have an impact on adolescent obesity are schools, fast food restaurants, convenient stores, and worksites, which will be discussed in more detail.

School environment influences adolescent obesity. Adolescents spend the majority of their time in the school environment (Story et al., 2002; Wordell, Daratha, Mandal, Bindler, & Butkus, 2012) and during that time those school experiences impact their actions both in and out of the school environment. Healthy meals offered in school have a positive impact on adolescents' dietary behaviors during school which carry over to dietary behaviors outside of school as well (Wordell et al., 2012).

In consideration of the time adolescents spend in the school setting, national effort has been made to improve the school food and nutrition environment (Wordell et al., 2012). Findings in a study by Wordell et al. (2012) on healthy changes in a middle school food environment showed positive food behaviors in adolescents. Three years prior to this study, policies reinforced changes made to the food environment throughout the school district. One policy eliminated sugary beverages and energy drinks, and allowed flavored waters and 100% fruit juice. Wordell et al. (2012) took it a step further by allowing two of six middle schools to carry only bottled water in vending machines and offering only milk and fruit on a la carte menus. At the end of the intervention, a food behavior study was conducted at both intervention and non-intervention middle schools to assess whether modification to the school food environments had an impact on students' food choices in and outside school. Of the 2,292 surveys returned by seventh- and eighth-grade students from the six middle schools, 24% of students in the intervention schools were more likely to consume milk outside of school, 27% were less likely to consume sugary beverages in school, and 56% were less likely to consume foods containing added fats and sugars in school. Their findings demonstrated that making positive changes to the school food environment had an overall positive impact on adolescents' food behaviors both in and outside of school.

Schools often incorporate a la carte items and food sold at school stores (also known as competitive foods) (Mobley et al., 2012). Although competitive foods generate profits for school revenue, these foods may also generate higher BMIs among adolescents. These foods are usually high in sugar and fat. In an effort to improve students' food choices, replacing these items with lower fat and lower sugar options were acceptable by students, which may help to lower energy intake over time. Recently, the United States Department

of Agriculture (USDA) (2013) published "Smart Snacks in Schools," which provides evidence-based nutrition standards for snack foods and drinks that are sold to children and adolescents in schools. These standards are part of the Healthy, Hunger-Free Kids Act of 2010 and will provide access to healthy snacks at schools for children to parallel the efforts in other environments. The USDA is committed to working with the food and beverage industry, school staff, parents, and the community to promote healthy lifestyle habits.

Aside from concerns about providing healthy food options in the school environment, concerns about limited nutrition and health education as well as physical activity opportunities outside of organized sports is evident (Kong et al., 2012). Certain factors have made it difficult to increase physical activity during school such as greater exposure to screen time and decreased physical education (Spruijt-Metz, 2011). Booth, Wilkenfeld, Pagnini, Booth, and King (2008) identified strategies to increase physical activity in schools after conducting focus groups with students. Students suggested that physical activity should incorporate a wide variety of activities to accommodate interests of all the students. Students wanted more consequences for students who tried to "ditch" physical education classes, and they voiced interest in having access to sporting equipment during lunch and recess as well as more options for physical activity programs after school.

Adolescent obesity interventions in the school-based setting should reinforce healthy lifestyles to adolescents, parents, faculty, and school administrators (Power et al., 2010). These interventions should address barriers for healthy lifestyles by implementing school policies (i.e. physical education classes and healthy food options) and providing evidence-based physical activity and nutrition education.

Convenient stores, fast food restaurants, and work sites influence adolescent obesity. Convenience stores and fast food restaurants, which predominantly carry less healthy food options, often are located near schools (Story et al., 2002). The proximity to schools makes these food items easily accessible to teens, and encourages the purchase and consumption of those foods. Fast food restaurants are a common place for teens to work, and they offer a social venue for teens all the while continuing their exposure to less healthy fast food (Story et al., 2002). While fast food establishments are making an effort to offer more nutritious food choices (Demory-Luce, 2005), adolescents often lack the knowledge on how to make those food choices and need to be taught those skills.

Efforts to help limit unhealthy food choices, promote physical activity, and provide nutrition education to adolescents (Flodmark, Lissau, & Pietrobelli, 2005) in and outside of the school environment is needed. Community personnel must come together and identify resources and actions to advocate for healthy changes in the physical environment and build partnerships with the food distribution and restaurant industries that affect eating and physical activity behaviors in youth (Story et al., 2002).

Macrosystem influences adolescent obesity. The macrosystem is a larger society that affects adolescents' eating behaviors such as the media, cultural and social norms, and food production and distribution systems (Story et al., 2002). The following paragraphs will focus on how advertising and media affect adolescents' eating behaviors. Advertising and other mass media include messages about food that affect adolescents' food choices.

Not only do various media sources promote sedentary behavior in adolescents, but it also increases their exposure to food advertising, which are not always favorable messages for healthy eating (Lobstein et al., 2004). Media saturates the environment (Story et al.,

2002) and can be found in adolescents' homes (family rooms and bedrooms), schools, and other community surroundings. Adolescents have access to television, websites, videos, magazines, all of which are sources of advertisements. With the increasing number of media channels, food advertisers have many avenues to target adolescents (Kaiser Family Foundation, 2004). Roberts, Foehr, and Rideout (2005) reported that children and adolescents ages 8 to 18 average 4 ½ hours of screen time daily (various media combined), resulting in an extended exposure to food advertisements.

Adolescents have become an important target audience of food advertisers for several reasons (Story & French, 2004; Story et al., 2002; Kaiser Family Foundation, 2004). Adolescents spend a large amount of their allowance and work-earned money in the food industry (Story & French, 2004; Story et al., 2002). Not only do adolescents spend their own money, but they also have a major impact on household food purchases by making requests to their parents. In addition, adolescents are future consumers (Story & French, 2004; Story et al., 2002), so targeting them at an early age could influence choices they make for a lifetime (Keller et al., 2012; Mason, 2012; Story & French, 2004; Story et al., 2002). Marketers believe that food advertising aimed at children and adolescents will influence brand awareness, brand preference, brand loyalty, and food purchases (Story & French, 2004).

Foods heavily marketed to children and adolescents are fast food, and foods high in sugar and fat (Keller et al., 2012; Story & French, 2004; Kaiser Family Foundation, 2004). These foods are being marketed to youth in obscure ways such as food branding and the use of their favorite characters and/or actors to promote a certain food within TV shows or movies (Keller et al., 2012; Story & French, 2004). For example in the movie *Home Alone*

an important clip included a Pepsi being spilled (Mason, 2012). Fast food corporations promote games and toys to go along with their meals with hopes that children will be attracted to their food, and cereal companies may offer a prize or toy inside the cereal box to lure youth to their brand (Story & French, 2004).

Increased portion size is another strategy food marketers use to get consumers to purchase their products as the perception of larger portions implies a more economical value to their food purchases (Ledikwe, Ello-Martin, & Rolls, 2005). Beginning in the 1970s, portion sizes have increased dramatically, with a sharp increase in the 1980s (Young & Nestle, 2002). Larger items were given names as a selling point (i.e. Super Size®, Double Gulp®). Items such as hamburgers and french fries can be 2 to 5 times larger than first introduced. Larger portion sizes are not limited to the restaurant industry, but also appear in food manufacturing (Albright et al., 2008; Division for Nutrition and Physical Activity [CDC], 2006). For example, a bottle of Coke® in the 1970s was about 13 ounces compared to 21 ounces in 1996 (Nielsen & Popkin, 2004). Young and Nestle (2002) found food portions in the marketplace exceed the federal standard portion sizes recommended for consumption. The increase in portion size parallels the prevalence of obesity (Young & Nestle, 2002) in that increased portions sizes along with increased consumption results in excess energy intake.

In response to the obesity epidemic, fast food restaurants such as McDonald's® and Wendy's®, have revamped their marketing efforts by renaming their largest sized portions, but the restaurants have done little to actually change the portion size (Young & Nestle, 2007). They have changed the names like Supersize, Biggie, and Great Biggie to Medium and Large. The change may fool consumers to believe they are getting smaller portions.

Since portion sizes greatly affect energy intake, and restaurants may not voluntarily reduce portions sizes, more attention from public health agencies is needed (Young & Nestle, 2007).

Changing the media is difficult, so educating youth on how to identify and analyze messages in advertisements is important (Story et al., 2002). Strategies are needed at every level within the community to help overcome environmental barriers and to enable adolescents to make healthy food choices. Understanding these barriers could help in the development of successful interventions for improving adolescent eating behaviors.

Adolescent Obesity Interventions

Many intervention models have been developed to prevent obesity (Sharma, 2006; Stice et al., 2006). Each model has specific aims: CVD prevention targeting obesity and other risk factors for CVD, prevention of weight gain, interventions that aim to increase physical activity, and education promoting healthy weight-management skills (Cowell, 2011; Flynn et al., 2006; Goh et al., 2009; Stice et al., 2006). Interventions for adolescents are intended to reverse or decrease the risk of immediate and long term complications (Lobstein et al., 2004; Romeo et al., 2011; Rosnov et al., 2011; Stice et al., 2006; Wilson, 2007). Due to the many factors that affect adolescent obesity, preventions and/or interventions should target families, schools, government policies, media, and health professionals (Lissau, Burniat, Poskitt, & Cole, 2002). This section will provide information on current adolescent obesity interventions. Furthermore, recommended guidelines within adolescent obesity interventions will be discussed along with characteristics that may make interventions successful. In addition, the role of RDNs in adolescent obesity interventions will then be discussed.

Types of adolescent obesity interventions. Many types of interventions have been developed, and various methods have been used to reach the same or similar health goals; increasing physical activity, improving nutrition, or increasing physical activity *and* improving nutrition, and reducing BMI (American Dietetic Association, 2006b; Cowell, 2011; Goh et al., 2009; Power et al., 2010; Stice et al., 2006). Types of interventions include school-based, where nutrition and physical activity education can take place (Gance-Cleveland & Bushmiaer, 2005; Gellar et al., 2012; Mauriello et al., 2006; Moore et al., 2009; Safron, Cislak, Gaspar, & Luszczynska, 2011; Sharma, 2006; Stoltz, Coburn, & Knickelbein, 2009), those that involve parent/caregiver and family interactions to promote healthy habits (Avery, Pallister, Allan, Stubbs, & Lavin, 2012; Boutelle, Birkeland, Hannan, Story, & Neumark-Sztainer, 2007; Burgess-Champoux et al., 2009; Golley, Hendrie, Slater, & Corsini, 2011; Kicklighter et al., 2007; Resnick et al., 2009), community-based to encourage community-wide healthy habits (McClaskey, 2010), and web-based or computer-based interventions to deliver nutrition and physical activity education (Casazza & Ciccazzo, 2007; Hamel, Robbins, & Wilbur, 2011). Changing policy often is the most effective way to implement and sustain environmental changes that have an effect on obesity (Bell, Rogers, Dietz, Ogden, & Popovic, 2011). Therefore, policy-driven interventions are also widely utilized (Bell et al., 2011).

School-based adolescent obesity interventions. The amount of time teens spend in school and considering the majority of teens are enrolled in school, the school setting is a convenient and effective way to deliver obesity interventions to adolescents (Sharma, 2006; Story et al., 2002; Wilson, 2007). Health and physical education (PE) classes can provide modest interventions by incorporating a nutrition curriculum and physical activity messages

respectively (Sharma, 2006). However, teachers and administrators do not have the expertise and they may not have enough time to focus on delivering thorough interventions, whereas health professionals with jobs that focus on interventions do (Stice et al., 2006). School-based interventions should contain multiple components to ensure their success: nutrition, physical activity, and behavior counseling (American Dietetic Association, 2006b; Sharma, 2006). When school-based adolescent obesity intervention programs have been implemented, adolescents' knowledge of healthy foods and self-efficacy increased (Moore et al., 2009).

Perhaps the most evaluated study is The Child and Adolescent Trial for Cardiovascular Health (CATCH) study (CATCH, 2013). The CATCH study was the largest funded school-based health intervention in U.S. history (funded by the National Lung and Blood Institute). The CATCH study took place from 1991-1994 in four states (California, Louisiana, Minnesota, and Texas), and included 96 elementary schools targeting third- through fifth-graders (56 intervention and 40 control) (Luepker et al., 1996). The CATCH study aimed to decrease overall fat, saturated fat, and sodium in over 5,100 children's diets. The study's aim was also to decrease use of tobacco and increase physical activity. Out of 56 intervention schools, 28 schools received school food modifications, enhanced PE, and a health curriculum in the classroom while the other 28 schools received family education in addition to the other components. Modifications to the school lunch menu were made and resulted in decreases in fat, saturated fat, and sodium. The health curriculum focused on healthy eating habits, physical activity and decreasing the use of cigarettes. The PE component increased the amount of moderate to vigorous physical activity to 40% of the total PE class time. Individual and school-level measurements such as anthropometric and

aerobic assessments were recorded at baseline (fall of 1991, third-grade) and again at follow-up (spring of 1994, fifth-grade). Results of the project indicated the CATCH program was successful in lowering consumption of fat and increasing physical activity among children and adolescents in intervention schools when compared with the control schools. The CATCH study demonstrated school-based interventions could be successfully implemented throughout the country, that it would be compatible with schools and their schedules when foodservice staff, teachers, and administrators were very involved. Follow-up studies show students who were participants in the original study continue to have lower fat intakes and increased levels of physical activity without further interventions than those students who did not participate (Nader et al., 1999). As a result of its success, CATCH has implemented other programs (CATCH, 2013). One notable program is CATCH Middle School, designed to promote healthy food choices and physical activity. Evaluations of this program have shown positive effects: reduced TV exposure, healthier food choices, and increased physical activity.

In more recent years, a school-based wellness program designed for youth was developed. This program is called Fuel Up to Play 60 (National Dairy Council [NDC], 2012) and was started in 2009 by NDC and the National Football League (NFL) in collaboration with the USDA. Over 70,000 schools are enrolled and nearly 11 million students actively participating in Fuel Up to Play 60, which promotes healthy eating habits by encouraging nutrient-rich foods and 60 minutes of daily physical activity. Fuel Up to Play 60 is a youth-led program guided by adult stakeholders to help make a positive impact in schools by giving children and adolescents opportunities to be more physically active and providing access to nutrient-dense food. The program offers funding opportunities, with

support from U.S. dairy farmer families, to schools who have limited resources. Fuel Up to Play 60 has a variety of resources available to enrolled schools that can help them meet their wellness goals: free starter kit (planning and implementing the program), interactive online playbook (strategies for healthy eating and physical activity), Fuel Up to Play 60 Challenges (helps maintain motivation and excitement through fun competition), incentives, and rewards. Examples of rewards are sending a deserving student to the Super Bowl and sending NFL players to selected schools to reward them for their accomplishments in reaching wellness goals. The website, FuelUpToPlay60.com, offers resources to youth where they can interact with each other, share stories, and provide tips for eating healthy and engaging in physical activity. Schools can also share their success stories and learn from each other. One success story occurred at Enslow Middle School in Huntington, West Virginia (NDC, 2012) in which the city was labeled "Unhealthiest Town in America," which gave students and staff motivation to become involved in the Fuel Up to Play 60 program. The entire student body committed to be involved in the program and their efforts aided in a 50-pound weight loss (among three grade levels) in the duration of one school year and earned them first place in the Fuel Up to Play 60 National Competition. The success stories are growing; and as more businesses, government, and communities get involved and support the Fuel Up to Play 60 program, funding is expected to grow as well (National Dairy Council, 2012).

Even brief and minimal impact school-based adolescent obesity interventions can have a positive impact on the adolescent obesity epidemic (Abood, Black, & Coster, 2008). Abood et al. (2008) evaluated the effect of a brief adolescent obesity intervention administered during school at various schools that included 551 teens. A PowerPoint

presentation called *Present and Prevent* was purchased at www.channing-bete.com. Topic areas focused on health consequences of obesity and importance of preventing obesity, body image, how to read a food label, benefits of a healthy body weight, healthy food choices, physical activity promotion, how to change habits, etc. Teachers delivered two 30-minute presentations during a 1-week period. Results from the post-intervention survey suggests that the minimal intervention program increased knowledge of nutrition with intentions to improve healthy eating behaviors, such as eating less fried and sugary foods, paying attention to food labels, and limiting exposure to TV. Surveys also showed that motivation to make healthier choices and maintain healthy body weights was associated to relationships with peers. Although this study revealed benefits of using minimal interventions in schools alone, they may be used as part of more intensive, multi-component adolescent obesity interventions that take place in school settings (Abood et al., 2008).

School-based interventions can utilize resources already in place such as PE and health classes, and school lunch to promote physical activity and healthy eating habits (American Dietetic Association, 2006b; Sharma, 2006). Adequate resources through advocacy efforts are needed for trained staff/experts to deliver well-planned, comprehensive, and high quality school-based adolescent obesity interventions (Morrison-Sandberg et al., 2011).

Family-based adolescent obesity interventions. Parents can act as powerful, healthy role models in their children's lives by modeling healthy food choices, serving appropriate portion sizes, limiting exposure to screen time, and encouraging physical activity (Raj & Kumar, 2010). Parents not only act as role models, but they also can be rule enforcers who hold their children accountable. For instance, having family members engage in physical

activity together will improve participation of overweight and obese children in these activities (Raj & Kumar, 2010).

Avery et al. (2012) evaluated a family-based approach to weight management called *Family Affair* in overweight and obese adolescents. *Family Affair* started in 2006 and provided support groups for adolescents aged 11-15 years with the involvement of the whole family in making healthier lifestyle changes. Before adolescents attended *Family Affair*, consultations by health experts such as dietitians, physicians, and psychologists were given to parents about the weight management effectiveness in adolescents. Avery et al. (2012) identified facilitators of groups with 6 – 18 adolescents who were asked to participate in a survey. The survey sought to identify which adults and family members attended *Family Affair* with the adolescents, if they were already members of the group, or if they joined with their child. It also aimed to find out why adults and/or family members attended (whether they joined for support for themselves or they joined to support their child). The survey intended to find what kind of advice adolescent participants were getting from health professionals (i.e. lose weight, slow weight gain, maintain weight, or adopt healthy eating and physical activity habits without worrying about weight).

Results of the survey provided valuable information related to teens. The majority of adolescents attended the support group with their mother with 1.5% attending with their father and 3.9% with both parents. Sixty-two percent of adults were members of the support group prior to their children joining, while 79% of adults joined the group with their children to gain weight management support for themselves. The parent(s) played a crucial role in adolescent's weight loss because the parent(s) had skills and abilities to provide healthy food options in the home as well as facilitate healthy activities. In addition to the

supporting parent, 60% of responses also mentioned that other family members attended weekly support groups. Only 59% of adolescents were given advice by a health professional, and just over a quarter of that advice was to slow current weight gain, 10.5% to maintain weight, 40.8% to lose weight, and 21.1% to adopt healthy eating and activity behaviors without worrying about weight loss. Important to note was the mean weight change of participants of -3.0 kg and the mean BMI change was -1 kg m^{-2} over the mean 12.5 weeks of attendance (although some were still attending weekly meetings). Results from this study indicate that a family-based approach to an adolescent obesity intervention would be appropriate in changing unhealthy habits to healthy habits in the home environment.

Efforts for designing family-based adolescent obesity interventions involve gaining knowledge about perceptions of family members regarding healthy eating and physical activity in the home environment (Berge, Arikian, Doherty, & Neumark-Sztainer, 2012). Focus groups revealed barriers and successes for eating healthy and being physically active (Berge et al., 2012). Barriers included time constraints with differing schedules/obligations, cost of food, and accessibility to physical activity. Successes identified from the focus groups were individual investment in healthy habits and family investment in healthy habits. Family members noted when one person in the family invested in healthy behaviors, the rest of the family was influenced. Family can act as a support group when one or more members try a new healthy behavior. Participants also commented that it was important to engage in healthy behaviors together, such as grocery shopping or learning a new sport, in order to foster relationships. Partaking in family meals and activities, making healthy habits fun and part of the family's lifestyle, and investments in family health by communities were keys for

successful family-based interventions. Family environment is most influential on child and adolescent healthy behaviors and thus targeting families for adolescent obesity interventions is important (Berge et al., 2012).

Web/computer-based adolescent obesity interventions. Web/computer-based adolescent obesity interventions can take place in various settings (Hamel et al., 2011). However, school settings (Casazza & Ciccazzo, 2007; Mauriello et al., 2006; Moore et al., 2009) and home settings (Williamson et al., 2006) seemed to be the most common location for web/computer-based interventions.

Health in Motion is a computer-based adolescent prevention/intervention program that focuses on three behaviors important for leading healthy lifestyles: increasing physical activity, limiting television exposure, and increasing consumption of fruit and vegetables (Mauriello et al., 2006). Each behavior targets the recommended guidelines (at least 60 minutes of physical activity per day, limiting TV to no more than 2 hours per day, and eating at least 5 servings of fruits and vegetables per day). *Health in Motion* utilizes the Transtheoretical Model of Behavior (TTM) (Prochaska & DiClemente, 1983) to assess users' readiness to change through a series of assessment questions after users log on. The TTM has five stages: Pre-contemplation, Contemplation, Preparation, Action, and Maintenance. Stage of change is an important predictor of an individual's behavior. An intervention, like *Health in Motion*, tailored to adolescents' stages of change may help them progress through stages and increase their likelihood of taking action (Prochaska, DiClemente, & Norcross, 1992). The program features multi-media components such as audio, video, animations, and interactive feedback to engage adolescents throughout the program (Mauriello et al., 2006). Each of the three intervention sessions, which are self-

directed, are intended to be delivered within 30 minutes. Mauriello et al. (2010) trialed the effectiveness of *Health in Motion* with 1800 students from eight high schools in four states (Rhode Island, Tennessee, Massachusetts, and New York) over a 14-month period. Although this program was designed to prevent adolescent obesity, it also served as an intervention, allowing adolescents of all weight and BMI classes to participate. The treatment group received three intervention sessions at baseline, 1 month, and 2 months with 6 and 12 month follow-up assessments while the control group completed four assessments only (at baseline, 2 months, 6 months, and 12 months). At the end of the intervention, Mauriello et al. (2010) found that the intervention group had increased their physical activity, increased their fruit and vegetable consumption, and decreased their exposure to TV. The control group also made positive changes, but not as significant as the intervention group. The most exceptional finding was the ability of the program to progress adolescents in the intervention group from the pre-contemplation stage to the action or maintenance stage in all three behaviors. Researchers concluded that a platform similar to *Health in Motion* can lead to healthier behavior changes among adolescents in a feasible manner. The self-directed intervention with the use of multi-media technology is cost-and time-effective, requiring little to no training for staff. In addition, this type of platform can be distributed widely to adolescents in multiple settings and provides tailored, brief sessions to impact multiple behaviors (Mauriello et al., 2010).

A 2-year web-based behavioral intervention that addressed nutrition education, included internet counseling on both nutrition and physical activity among adolescent girls, and included parental involvement, led to a loss of weight and body fat compared to the control group who received web-based health education (Williamson et al., 2006).

However, weight decreased in parents and body fat decreased in adolescents during the first 6 months. The internet counseling occurred within the first 12 weeks of the intervention and even though participants had continued use of the website for the final 18 months, participation in counseling declined and the weight lost as well as body fat lost was regained, which resulted in no significant differences between the intervention and control groups. Williamson et al. (2006) concluded that this interactive web-based program in the home setting was not effective for long-term weight and fat loss and strategies for sustaining such programs should be considered in the future such as increased supervision in its use.

Computer-based interventions that include interactive and animated components to promote healthy lifestyle changes may provide a platform conducive to adolescents' learning styles and, in turn, lead to a greater chance for behavior change (Casazza & Ciccazzo, 2007). Suggestions for successful web-/computer-based adolescent obesity interventions include involving parents or peers, integrating into the school setting, tailoring to individuals' needs, and using a theoretical framework when designing the intervention (Hamel et al., 2011).

Community-based adolescent obesity interventions. Community-based adolescent obesity interventions require the collaboration of community health centers, clinicians, family, and the community to enhance the success of the intervention (McClaskey, 2010). The intervention described below is one of many ways community-based interventions are defined (American Dietetic Association, 2006b).

Upper Cardozo Clinic located in Washington D.C. is a primary care clinic that encounters childhood and adolescent obesity regularly (McClaskey, 2010). Physicians from this clinic found that referrals were not being utilized, and they lacked the time to properly

address obesity at routine visits. Reasons for poor use of referrals were time, distance, and the unfamiliarity of person being referred to. After a failed attempt to offer an obesity clinic for children and adolescents aged 7 to 13, the Unity Upper Cardozo Health Center partnered with the local Young Man's Christian Association (YMCA) and the Diabetic Research Wellness Foundation to offer and childhood obesity prevention program. The YMCA, a community health and fitness center, was an appropriate agency to lead the physical activity component of the intervention. The Diabetic Research Wellness Foundation provided funding for the program. The intervention team educated the staff at the Upper Cardozo Clinic about the project and spoke to them about referring potential participants. *We Can!* (Ways to Enhance Children's Activity and Nutrition) (National Heart, Lung, and Blood Institute, 2005) is a nationally recognized childhood obesity program that was chosen by the intervention team as the template for nutrition and physical activity education classes that targeted families of overweight and obese children ages 7 to 13. Educational classes began with a healthy dinner followed by a facilitated discussion among families about what they learned in the previous lesson and any barriers they might have encountered in reaching goals. After dinner, children and adults were divided into groups to receive age-appropriate nutrition education. After the session, a YMCA staff member led the children in different types of physical activity, indoors and outdoors, providing a safe atmosphere for physical activity that might not otherwise be available. At the end of the divided lessons, adults and children came back together to discuss what they learned and to set goals based on the new information. Due to the success of this intervention, measured by participant surveys, efforts are being made to expand this program into other Unity Health clinics (McClaskey, 2010).

The above example is an intervention that is delivered to participants using community collaboration defined as a community-based intervention (American Dietetic Association, 2006b). Effective community-based adolescent obesity interventions should deliver healthy lifestyle messages using multiple approaches and partnerships and requires good leadership and thorough planning (Fotu et al., 2011). One approach to include in community-based interventions is the promotion of nutrition and physical activity to the whole community through social marketing (American Dietetic Association, 2006b). Another approach to incorporate into community-based interventions is making changes to public policies or developing new policies, which is discussed in detail below.

Policy-driven adolescent obesity interventions. Clinical providers and policy makers have given less attention to the short-term impact of childhood and adolescent obesity than the long-term impact affecting adults (Reilly & Kelly, 2011). A prolonged duration of obesity may lead to the incidence of comorbidities in a person, and evidence shows a long-term effect of childhood obesity may prompt clinical providers and policy makers to consider more prevention and intervention programs. Proactive protection from childhood disease can help minimize the probability of many chronic diseases later in life (Schafer & Ferraro, 2012).

In response to the implications of obesity and the health care costs accrued, aid in developing interventions are aimed at policy-makers (Raj & Kumar, 2010; Withrow & Alter, 2011). To influence healthy choices of individuals and families, multiple settings such as child care facilities, schools, worksites, and communities can implement policies that promote healthy lifestyles (Benjamin, 2010) such as the nutritional changes in school-lunches and the environment (Grant & Manuel, 2011; Mobley et al., 2012; Wordell et al.,

2012) . Themes identified from focus group interviews with policy planners and members in Atlantic Canada (Grant & Manuel, 2011) included a need for better communication and collaboration within the government and community systems to increase understanding between the built environment and health outcomes for youth. An understanding of what and how factors cause adolescent obesity will help in the successful planning for policy-driven interventions (Grant & Manuel, 2011).

Policy-driven interventions that combat childhood and adolescent obesity as well as adult obesity, can address local, state, or federal policy changes to improve nutrition and physical activity environments (Schwarte et al., 2010). Advocates and policy-makers tend to aim their initiatives at school environments because of the substantial amount of time children spend there (Ryan, Card-Higginson, McCarthy, Justus, & Thompson, 2006). Creating a healthy, safe, and supportive school environment can be conducive for positive behavior changes in nutrition and physical activity. However, due to the multiple factors outside of school that influence adolescent obesity, efforts are made to change policies and to develop programs to address food marketing, restaurant nutrition labeling, public food assistance programs, and safe environments for physical activity (Daniels et al., 2005; Ryan et al., 2006). Policy changes to these components will help to combat obesity in the whole community.

Examples of policy changes in the physical environment are modifications to the nutrition standards in the National School Lunch and School Breakfast Programs to make meals healthier in the school environment (USDA: Food and Nutrition Service [FNS], 2012; Williamson, Han, Johnson, Martin, & Newton, 2013) and the nutrition labeling laws of restaurant menus to promote healthy food choices by consumers (Corby-Edwards, 2012;

USDA, 2013a). Changes made to the nutrition standards in school meals are intend to decrease portion sizes, fat, saturated and trans fats, and sodium; while increasing the offerings and consumption fruits, vegetables, dairy, and whole grains (USDA: FNS, 2012). Williamson et al. (2013) found that making modifications to the school food environment improves healthy eating and the quality of nutritional intake among students. As the availability of healthy foods increased so did the intake of those foods, and as portion sizes were decreased so were the amounts consumed.

While labeling laws of packaged foods have been in effect since 1990s (Corby-Edwards, 2012; USDA, 2013b), recent changes in policy have been made to extend nutrition labeling to chain restaurants with 20 or more locations to address the rising obesity rates and increasing health care costs (Corby-Edwards, 2012). Targeting the restaurant industry for nutrition labeling is important because teens spend a lot of their money on restaurant food (Story & French, 2004; Story et al., 2002) and consumers tend to greatly underestimate the amount of calories in restaurant meals (Burton, Creyer, Kees, & Huggins, 2006; Corby-Edwards, 2012; Wansink & Chandon, 2006). For example, Wansink and Chandon (2006) found that customers underestimated the calorie content of their lunch by 23% when dining at a fast food restaurant. Burton et al. (2006) found that consumers, on average, underestimated restaurant meals by 600 calories or more, which when doing the math, calculated to a weight gain of 9 pounds a year if consumers ate one meal a week in which they underestimated by 600 calories or more. Listing calorie contents on restaurant menus is a way to increase awareness of how many calories consumers are eating (Corby-Edwards, 2012). Burton et al. (2006) also found that consumers were more likely to choose healthier items from menus when given calorie and nutrient information. However, those who look to

nutrition labels in making their food choices tend to have healthier diets (Campos, Doxey, & Hammond, 2011).

Adolescents are one of the groups that are less likely to use nutrition labels, and often lack the knowledge on how to read food labels and calculate serving sizes (Demory-Luce, 2005). Therefore, efforts need to be made to educate adolescents on how to read nutrition labels and make healthier choices. One tool the National Restaurant Association developed in collaboration with Healthy Dining to combat childhood obesity is the Kids LiveWell program (National Restaurant Association, 2013). The aim is to help parents and children make healthy choices while dining out. With almost 30,000 restaurant locations already participating on a voluntary basis, menu items for children are intended to decrease calories, total fat, saturated and *trans* fats as well as sugar and sodium. At the same time, the Kids LiveWell program seeks to promote the consumption of fruits, vegetables, lean protein, low-fat dairy and whole grains. This program showcases the policy efforts of the restaurant industry in the fight against childhood and adolescent obesity.

Although voluntary attempts are being made to combat childhood and adolescent obesity (as well as adult obesity) in the food and restaurant industry, food advertising and marketing continues to impact adolescents' food choices, with most food advertisements consisting of energy-dense food with low nutritional value (Keller et al., 2012; Story & French, 2004). Many views exist on how marketing food to children and adolescents should be addressed (Mason, 2012); from industry self-regulation and government-led voluntary policies to statutory law. Future research is needed to identify which policy method has the greatest impact (Mason, 2012; Mello, 2010).

In regards to the community involvement in physical activity, The U.S. Department of Transportation's Federal Highway Administration is committed to empowering communities to make routes to safe to school in order to increase walking and biking activity among children and parents (United States Department of Transportation Federal Highway Administration, 2013). This Federal-Aid program is called Safe Routes to School, providing funds to the States for planning, developing, and implementing strategies that will help to improve traffic issues and safety within two miles of primary and middle schools. These changes will help increase physical activity and decrease air pollution in the vicinity of schools.

States and regional areas have come up with strategies for policy-driven interventions to fight the childhood and adolescent obesity epidemic (Ryan et al., 2006; Schwarte et al., 2010). Arkansas has made an effort to design or change policies and develop interventions aimed at reducing childhood obesity in their state (Ryan et al., 2006). They target a framework with four key components: assessment, population interventions, individual interventions, and ongoing surveillance for sustainability. Arkansas recognizes that putting evidenced-based material to policy and practice requires a comprehensive plan with intense collaboration between government and community leaders.

A community-based obesity prevention program called the Central California Regional Obesity Prevention Program (CCROPP) took place in eight central California counties known as a leading region in agriculture (Schwarte et al., 2010). The CCROPP utilized local and regional resources to implement a program to increase access to healthy food and physical activity opportunities in low-income, disadvantaged communities. The CCROPP was implemented by local public health departments in each county, community-

based organizations, and obesity councils by use of a model (CCROPP Model of Change), which illustrates the developmental processes, transformative processes, and outcomes. In a community collaboration effort, neighborhoods, community partners (i.e. farmer's markets, schools, local businesses, city planners), and local policy-makers came together to help implement change for a healthier community. The CCROPP took place from 2006-2009, with an extension of funds into June 2010. Progress has been made in the implementation of interventions and strategies in the Central California community, indicating positive outcomes may occur in the nutrition and physical activity environments of low-income, disadvantaged communities. However, additional time is needed to reach desired outcomes of the CCROPP. Researchers need to continuously assess the impact of the CCROPP to determine if policy change has led to a healthier community (Schwarte et al., 2010) and report on what worked and what did not work to the state and national levels in order to provide strategies in the fight against obesity on a larger scale.

Adolescent obesity interventions should aim to incorporate policy and environmental changes with nutrition and physical activity education and individual behavior counseling to enhance their impact on adolescents' health with sustainable effects (Almarzooqi & Nagy, 2011). Strategies for interventions should include public health professionals, families, community leaders, the healthcare system, government agencies, schools, and the food industry (Daniels et al., 2005). Ongoing testing and evaluating of adolescent obesity interventions are needed to provide evidence-based practices for policies and programs.

Characteristics of successful adolescent obesity interventions. Interventions that involve parents, cognitive and behavioral strategies, reinforcement to increase physical activity or decrease sedentary activity such as reducing screen time, and promote healthy

eating combined into one program have been shown to be more effective (Collins et al., 2007; Flattum, Friend, Story, & Neumark-Sztainer, 2011; Foltz et al., 2011; Golley et al., 2011; Stice et al., 2006; Wilson, 2007). A few studies also focused on adolescent obesity interventions that included peer involvement to enhance confidence and self-efficacy for making healthy changes (Jelalian et al., 2011; Utter, Warbrick, Scragg, Denny, & Schaaf, 2010).

Parent/family involvement. Golley et al. (2011) conducted a review of literature and found that effective childhood and adolescent obesity interventions were those that included parental involvement using behavior change techniques. While not all studies with parental involvement proved effectiveness, similarities in effective programs have been identified: greater parental involvement that identified barriers for their participation, healthy changes to the home environment, goal setting, self-monitoring, and having parents being responsible for involvement and implementation of strategies.

Parents are responsible for feeding practices inside the home (Berge et al., 2012; Daniels et al., 2005; Golley et al., 2011). Parents implement family meals and set the environment for those meals, including which food choices will be offered (Daniels et al., 2005). Strategies for parental involvement are to include children and adolescents in the planning, shopping, and preparation of food, which may improve healthy eating patterns and consumption.

Involving parents and the whole family as part of multi-component childhood and adolescent obesity interventions has proven to be successful (Golley et al., 2011; Stice et al., 2006), demonstrating that not only do they provide healthy home environments, but parents may aid in strengthening family bonds (Berge et al., 2012). Despite overall effectiveness of

adolescent obesity interventions that involve parents and/or family, barriers must be addressed to initiate and sustain their involvement using carefully planned approaches to promote positive behavior changes in the home environment (Berge et al., 2012; Golley et al., 2011).

Cognitive and behavioral strategies. Interventions aim to increase self-efficacy for physical activity and making healthy choices (Araújo-Soares, McIntyre, MacLennan, & Sniehotta, 2009; Nystrom, Schmitz, Perry, Lytle, & Neumark-Sztainer, 2005; Robbins et al., 2012) through behavior counseling and motivational interviewing methods (Contento, Koch, Lee, & Calabrese-Barton, 2010; Flattum et al., 2011; Luzier, Berlin, & Weeks, 2010; Walpole, Dettmer, Morrongiello, McCrindle, & Hamilton, 2011). Motivational interviewing is a counseling approach used to promote behavior change by reinforcing the individual's self-motivation and self-efficacy (Flattum et al., 2011) and can be successful in increasing positive behaviors, but there is no conclusive evidence that it helps decrease negative behaviors.

Motivational interviewing such as the 5 A's (Assess, Advise, Agree, Assist, and Arrange), which will be discussed later in more detail, has been tested primarily with adults and seem appropriate with children (Taft, Collier, & Kolasa, 2012). However, more studies are needed to determine usefulness of motivational interviewing with children (Taft et al., 2012). The hope is that future studies using motivational interviewing as a technique to treat childhood and adolescent obesity will produce results that show a positive effect on their self-esteem and self-efficacy for physical activity and making healthy food choices (Walpole et al., 2011).

Contento et al. (2010) delivered a curriculum intervention to adolescents called *Choice, Control & Change.* The aim of this program was to improve healthy behaviors using cognitive and self-determination theories to increase self-motivation. Teachers delivered the curriculum after receiving intense training. The outcome of the curriculum led to decreases in frequency and size of sugary snacks and beverages as well as reduced screen time and increased intentions of physical activity. No impact on fruit, vegetable, or water intake occurred. While this study showed mixed results, it demonstrated that adolescents may respond to this type of approach, and that it may be used in other adolescent interventions delivered by nutrition educators or other health professionals (Contento et al., 2010).

Physical activity component/reducing screen time. Combining components that promote increases in physical activity and decreases sedentary activities are optimal in achieving and maintaining a healthy weight (Wilson, 2007). Increased screen time in adolescents is inherently linked to decreased physical activity (Pedrosa et al., 2011). Wilson (2007) identified exercise as the number one component adolescents were willing to engage in when involved in an adolescent obesity prevention intervention program as long as the type of exercise was considered fun by the adolescents.

Physical activity in youth is important for maintaining a healthy weight and improving cardiovascular health (National Heart, Lung, and Blood Institute, 2011). Strong evidence suggests that interventions stressing physical activity improve blood pressure and cholesterol levels, and decrease body fat. Physical activity habits established in childhood and adolescence are more likely to be continued into adulthood (National Heart, Lung, and Blood Institute, 2011). The Expert Panel on Integrated Guidelines for Cardiovascular

Health Risk Reduction in Children and Adolescents recommends that physical activity in children and adolescents should be at least 60 minutes every day with three days per week consisting of vigorous activity such as running, which is consistent with the recommendations made in the "2008 Physical Activity Guidelines Advisory Committee Report" by the from the U.S. Department of Health and Human Resources. Also recommended is limiting screen time to less than two hours per day in order to reduce sedentary time, consistent with recommendations made by the American Academy of Pediatrics (AAP) (American Academy of Pediatrics [AAP], 2013).

Making recommendations for physical activity and reducing screen time is important, but including these strategies as components in adolescent obesity interventions will leave adolescents with the knowledge and skills they can use for a lifetime (Stice et al., 2006). Although knowledge about physical activity and its benefits are important among adolescents, interventions should aim to measure changes in physical activity behaviors such as changes in screen time and the time spent being physically active (Almarzooqi & Nagy, 2011). In a review of studies that included physical activity components in adolescent obesity interventions, overall results showed that there was an increase in the amount of time participants engaged in physical activity in and outside PE classes, with an increase of 83 minutes per week of moderate to vigorous physical activity (van Sluijs, McMinn, & Griffin, 2007).

Physical activity as part of a multi-component adolescent obesity intervention can aid in successful and sustainable outcomes for healthy lifestyle habits and improving BMI status (Safron et al., 2011; Stice et al., 2006). School-based interventions may be most effective in delivering physical activity components due to its convenient location for

adolescents, where PE teachers, coaches, and after-school program coordinators can collaborate with health professionals and other community members in its design (Robbins et al., 2012). Strategies to increase physical activity should focus on reducing sedentary behaviors and providing opportunities to engage in physical activity (Safron et al., 2011). Adolescents are willing to participate in physical activity if the activity is perceived as fun (Wilson, 2007), therefore it is important to consider their opinions when planning components to increase the effectiveness of the program.

Peer involvement. Peers may act as positive support for each other while undergoing changes in healthy behaviors (Jelalian et al., 2011), which lead to a reduction in adolescent perception of peer rejection and self-anxiety. The improvement of self-concept through group sessions with peers resulted in increased activity participation in the adolescent obesity intervention and a reduction in BMI (Jelalian et al., 2010). Utter et al. (2010) discusses the development of student health councils as part of peer involvement for school-based adolescent obesity interventions. Having adolescents involved in developing the nutrition and exercise activities may result in increased participation, viewed as "cool" by participants. Students involved in the study were responsible for creating activities and sustaining their efforts for interventions. Students on health councils attended training to learn skills such as goal-setting and enhance their confidence as role models. Involving peers in adolescent obesity interventions is an acceptable method for engaging other adolescents in the intervention (Utter et al., 2010). However, adolescent obesity interventions that involve peers, such as this one, need guidance, training, and support from adults to enhance their success.

Nutrition component. Aside from all the factors that contribute to adolescent obesity, the condition is primarily the result of energy intake exceeding energy expenditure (Wilson, 2007). Thus, prevention and intervention efforts must address this. Adolescent obesity interventions that include nutrition components with dietary modification have shown to be effective in reducing weight (Collins et al., 2007; Hollar et al., 2010). Dietary modification is a major component of successful treatments for obesity (Collins et al., 2007). Including a nutrition component enhance long-term effects of adolescent obesity interventions (Safron et al., 2011). Nutrition components may have different strategies while aiming for the same goal: to increase healthy food choices among adolescents (Mobley et al., 2012). Mobley et al. (2012) and Hollar et al. (2010) both sought to improve adolescent dietary habits by making healthy food modifications in the school environment, which showed to be successful. Other nutrition components focus on making healthy food choices by means of nutrition education (Casazza & Ciccazzo, 2007; Moore et al., 2009).

While the nutrition component in adolescent obesity interventions is the key to their successes, it is uncommon that the nutrition component is the sole component, due to the multiple factors that contribute to adolescent obesity (physical activity, etc.) (Collins et al., 2007). Furthermore, with multiple approaches being used to improve dietary habits, researchers must describe the details of their effective dietary interventions for others to replicate in future interventions.

Adolescent obesity interventions should be multi-component programs to address the many factors that contribute to adolescent obesity (Almarzooqi & Nagy, 2011; American Dietetic Association, 2006b; Collins et al., 2007; Sharma, 2006; Stice et al., 2006), which include nutrition, physical activity, and behavior counseling components along with

parent/family and peer involvement. The inclusion of these components in one program has shown to be effective. In addition, when evaluating adolescent obesity interventions and their components, it's important to consider the duration of the program and address adolescents' barriers to making healthy changes (Almarzooqi & Nagy, 2011; Stice et al., 2006). Furthermore, guidelines within components are useful tools for providing evidence-based education and evaluation methods (Foltz et al., 2011; Taft et al., 2012). Guidelines for adolescent obesity interventions will be discussed in the following section.

Guidelines for adolescent obesity interventions. Foltz et al. (2011) identified guidelines set forth by Blue Cross Blue Shield of Massachusetts and the Maine Youth Overweight Collaborative as the 5-2-1 message and the 5-2-1-0 campaign respectively: 5 or more servings of fruits and vegetables, < 2 hours of screen time (TV, video games, and computer), at least 1 hour of physical activity, and no (0) sugar-sweetened beverages (all daily). These initiatives were intended for physicians to apply the 5-2-1-0 mnemonic when providing nutrition and physical activity recommendations in pediatric weight management and behavior counseling. No dataset exists to examine the four behaviors since the development of the 5-2-1-0 goals, so Foltz et al. (2011) evaluated nutritional and physical activity behaviors of adolescents on how they would have been measured based on the 5-2-1-0 goals. Only 0.4% of adolescents would have met all four goals for obesity prevention and 41% would not have met any of the goals. The findings of this data can provide a baseline to guide adolescent obesity interventions, provide a goal for adolescent behaviors in future interventions, and also serve as a guide for health professionals when counseling adolescents about healthy behaviors.

Taft, Collier, and Kolasa (2012) utilized the Integrated Guidelines for Cardiovascular Health Risk Reduction in Children and Adolescents, developed by the National Heart, Lung, and Blood Institute (2011) Expert Panel, as their nutrition component for patient-centered counseling when treating obese children and adolescents. The Expert Panel Integrated Guidelines for Cardiovascular Health and Risk Reduction are evidence-based age-specific recommendations by risk factor: family history, age, gender, physical inactivity, nutrition/diet behaviors, tobacco use, overweight/obesity, pertinent lab values, and disease conditions (National Heart, Lung, and Blood Institute, 2011). For example, the Expert Panel accepts the 2010 *Dietary Guidelines for Americans* (2010 DGA) as appropriate recommendations to use, but also supports incorporating other methods that focuses on the reduction of CV risk such as the *DASH Diet* (Dietary Approaches to Stop Hypertension). Integration of dietary recommendations was named Cardiovascular Health Integrated Lifestyle Diet (CHILD 1). Age-specific dietary recommendations, coupled with graded evidence reviews, provide a comprehensive tool for health professionals to use. The Expert Panel developed these guidelines/recommendations with the hope that it will be a useful tool for health clinicians when providing health care to overweight and obese children and adolescents.

Obese individuals need to be treated with behavioral therapy to better aid in the prevention of chronic illness or debilitating disabilities (Centers for Medicare and Medicaid Services, 2011). Medicare extends coverage for obesity screening and behavioral counseling; however, in order for these services to be covered, the 5 A's framework should be used that were developed by the US Preventive Services Task Force for smoking cessation, physical activity, and diet (US Preventive Services Task Force, 2010; Taft et al.,

2012). The 5 A's stand for Assess, Advise, Agree, Assist, and Arrange. **Assess:** This would be the subjective and objective information that the clinician would obtain from the patient's chart and from interviewing the patient. This would also be the step to determine the patient's readiness to change. **Advise:** This is the stage where the clinician would advise the patient to make changes (i.e. weight loss and lowering blood pressure by following a particular diet). **Agree:** The dietitian and patient come to agreements as to what goals are appropriate and attainable. The goals must be specific, reasonable, and timely. **Assist:** The dietitian provides nutrition education and strategies to the patient to assist in reaching goals. **Arrange:** In this step, the dietitian/clinicians will arrange resources for the patient such as classes offered in the community and maintenance counseling. Clinicians do well asking and advising, but may not successfully use the rest of the steps when treating an obese child (US Preventive Services Task Force, 2010; Taft et al., 2012). Assessing for readiness to change is often overlooked by clinicians. Eighty-three percent of physicians used at least 1 of the 5 A's when working with obese adults and only about 5% complete all steps (Alexander et al., 2011). Patients had higher weight loss when they received the "Arrange" step.

Treating childhood and adolescent obesity requires the collaboration between healthcare teams (Alexander et al., 2011). In order to make counseling effective, each team member must be skilled in using each stage of the 5 A's (Taft et al., 2012). Taft et al. (2012) concluded, after evaluating their case studies using the 5 A's framework and applying Integrated Guidelines for Cardiovascular Health Risk Reduction in Children and Adolescents, that no matter how comprehensive the obesity treatment, patients and their families must be a dedicated part of the team in order to make their treatments effective.

Healthcare workers can assess and evaluate evidence-based guidelines to use in practice that will best support their obese patients.

Use of RDNs in adolescent obesity interventions. Registered dietitian nutritionists have been utilized in various obesity intervention models, composing and delivering nutrition components (Collins et al., 2007). Programs that use inexperienced individuals in the delivery of obesity interventions could result in negative outcomes, even though they are considered evidence-based interventions (Burghen, 2005). Registered dietitian nutritionists have been used in school-based obesity interventions to make menu modifications to the school lunch menu and to deliver nutrition curriculum (Hollar et al., 2010). Hollar et al. designed HOPS to test a school-based obesity intervention among 6- to 13-year olds over two school years. The intervention included nutrition and physical activity components with an overall goal to improve overall health status (reduction of BMI percentiles and blood pressure). The nutrition component required extensive modifications to the school breakfast, lunch, and snack menus by an RDN. Modification to menus increased the amount of high-fiber items (i.e. whole grains and fresh fruits and vegetables) and decreased the amount of processed food items, lowering the amount of high-sugar items and reducing total fat, saturated fat and *trans* fat. Registered dietitian nutritionists worked closely with the USDA FNS, school administration, and cafeteria staff to ensure intervention accuracy. In addition to menu modification, RDNs delivered school-based holistic nutrition education to emphasize a healthy lifestyle. Curriculum was delivered to students, their parents, teachers, and other staff. Results of the two-year study showed significant decreases in weight and blood pressure in girls and slight improvements in boys for both categories. These results indicate that obesity interventions in schools that make modifications to menus and provide

nutrition and physical activity education may improve health to school-aged children. School-based RDNs are crucial to ensuring the success of the nutrition component in the intervention (Hollar et al., 2010).

In addition to the school setting, adolescent obesity interventions may also take place in primary care settings or pediatric hospitals (Díaz et al., 2010; Marqués et al., 2012). Registered dietitian nutritionists can provide nutrition consultations and education to adolescents and their parents in these settings to improve the successful outcomes of lifestyle changes (Díaz et al., 2010). Additionally, RDNs are the experts that can identify eating disorders among adolescents and assess if intervention methods could increase their risk or further eating disorders (Marqués et al., 2012).

An adolescent obesity intervention program called Wellness Incentive to Health (WITH) was a pilot study that called on experienced RDNs to deliver the nutrition component to twenty teen participants (Ramsay et al., 2013). A physical activity component was included and participants were given a Bodybugg®, a wearable digital device accompanied by web-based tools to monitor daily calories and exercise. The goal of the program was to improve the health and fitness of obese adolescents. Registered dietitian nutritionists provided one-on-one counseling sessions to participants to assess dietary intake, discuss individual goals, and to recommend proper intakes of carbohydrates, protein, and fat. Registered dietitian nutritionists evaluated nutrition and activity data that participants entered into the Bodybugg® website to aid in their individual assessments. In addition, RDNs provided six nutritional education group sessions to participants. Topics covered overall healthy eating, goal setting, how to read a food label, and healthy meal preparation techniques. One class took participants to an area restaurant where the emphasis was on

strategies to select healthy choices from the menu. Parents and siblings were also encouraged to attend educational sessions to reinforce and influence health in the home environment. On-going nutrition counseling was available as requested. Procedures and results of the study have been published elsewhere.

As described above, RDNs are valuable to any type of obesity intervention (Collins et al., 2007; Kushner & Neff, 2010). Registered dietitian nutritionists use their expertise in nutrition and counseling skills in the prevention and treatment of obesity care and /or disease management (Kushner & Neff, 2010).

In developing an effective adolescent obesity intervention program, gathering adolescents' preferences on components they believe is important and acceptable is needed (Wilson, 2007), and will increase their likelihood of adopting healthy lifestyle habits. Wilson (2007) identified components such as physical activity and eating healthy that adolescents deemed important to be included in obesity interventions to help achieve and maintain a healthy weight. While this data is valuable, additional information on adolescent perceptions regarding the nutrition component is needed, as well as their perceived benefits of having experts such as registered dietitian nutritionists involved in designing and delivering the component.

Summary

Little progress has been made in the reduction of the prevalence of adolescent obesity (Ogden et al., 2012). Adolescent obesity poses a risk for many health consequences, both short- and long-term (Ortega et al., 2008; Rosnov et al., 2011; Schwimmer et al., 2003). Immediate health consequences were virtually unheard of in children and adolescents until the prevalence of obesity among this population (Daniels et al., 2005). Children and

adolescents who are obese tend to be obese as adults which increases risk of health consequences into adulthood (Daniels et al., 2005; Dietz, 1998; Reilly & Kelly, 2011). Therefore, long-term health consequences are associated to adolescent obesity if no improvement in health is made. To reverse the trend of adolescent obesity and the rising health care costs associated with it, it is critical to determine the most effective approach for treatment and prevention (Daniels, 2006).

In order to determine the best approach for treating adolescent obesity, factors associated to its prevalence must be addressed (Storey et al., 2003). However, there is no one exact factor that leads to obesity. Instead, factors tend to overlap and co-exist in relation to one another (Spruijt-Metz, 2011). Many adolescent obesity intervention models exist with the inclusion of multiple components that aim to make a positive impact on adolescents' lifestyle habits (American Dietetic Association, 2006b; Cowell, 2011; Goh et al., 2009; Power et al., 2010; Stice et al., 2006). The methods and outcomes of interventions should be continuously evaluated to aid in the development of future effective adolescent obesity interventions that utilize evidence-based guidelines/recommendations (Almarzooqi & Nagy, 2011; Daniels et al., 2005; Stice et al., 2006). Furthermore, the use of healthcare experts (i.e. RDNs, doctors, school nurses, etc.) to deliver specific components is important in the quality and effectiveness of adolescent obesity interventions (Burghen, 2005).

While many types of interventions exist to help tackle adolescent obesity, there is no definite evidence on how to maximize the impact of adolescent obesity interventions. Although data has been collected to identify what components adolescents perceive to be important in adolescent obesity intervention programs, there is no known data that identifies adolescents' perceived benefits of having registered dietitian nutritionists involved in

adolescent obesity interventions. Gathering data on adolescents' perceptions will aid in developing successful adolescent obesity intervention programs (Wilson, 2007). Therefore, the purpose of this study was to determine adolescents' perceptions regarding the usefulness of registered dietitian nutritionists in an adolescent obesity intervention: WITH program.

CHAPTER THREE

An Adolescent Nutrition Learning Model to Facilitate Behavior Change in a Teen Obesity Intervention Study

Abstract

Adolescent obesity increases the risk for adult obesity and morbidity. Registered dietitians nutritionists (RDNs) are involved in adolescent obesity interventions intended to reverse or decrease immediate and long term complications. Qualitative methodology was used to identify perceived usefulness of RDNs to change adolescent nutrition behaviors in an obesity intervention study: Wellness Incentive to Health (WITH) program. Ten participants (adolescents between 15-17 years of age, 2 males and 8 females) were interviewed. A questionnaire guide was developed to ask participants about their knowledge of RDNs, the benefits of having RDNs in the program, and what they learned from RDNs. Participant interviews lasted approximately 30 minutes, were audio-recorded, and transcribed. Audio transcriptions were systematically coded and analyzed to identify central themes. Nine of ten participants reported little to no knowledge about RDNs *before* participating in the WITH program. Four overarching themes were identified and formed the Adolescent Nutrition Learning Model from participant responses: 1) *RDNs Provide Nutrition Information* (i.e. why and how food benefits the body, information about healthy cooking and preparation of food; and information about healthier food behaviors (i.e. portion sizes, reading labels, and recognizing satiety)*;* 2) *Adolescents Prefer Hands-On Activities* (i.e. cooking activities, tasting foods, going out to restaurants, and working in groups); 3) *Adolescents described their Change in Behavior from Concepts Learned* (i.e. learned how to eat healthy in social adolescent settings); and 4) *Adolescents disliked logging food*.

Registered dietitian nutritionists in an adolescent obesity intervention program were perceived to have provided valued nutrition expertise and an Adolescent Nutrition Learning Model may be useful in guiding nutrition education for teens.

Introduction

Between 1980 and 2010, the number of adolescents 12-19 years of age who were considered obese increased from 5% to 18% (Centers for Disease Control and Prevention [CDC], 2012a). Adolescent obesity has a major impact on the prevalence of adult obesity, as obesity in adolescence presents a long-term risk factor for obesity and morbidity in adulthood (Dietz, 1998; Spruijt-Metz, 2011). Health care professionals, including registered dietitian nutritionists (RDNs), help to reduce this trend by serving as role models for healthy lifestyle habits and serving as experts in their area of health information (Benjamin, 2010).

Registered dietitian nutritionists should be included in the collaborative health care team to customize and emphasize health lifestyle behaviors (Lichtenstein, 2007). Registered dietitian nutritionists determine individual energy needs, track energy intake and expenditure, provide tips on healthy food choices and preparation, and provide guidance on portion sizes, etc. (Lichtenstein, 2007; American Dietetic Association, 2006a; Rhea & Bettles, 2012). Registered dietitian nutritionists have been involved in collaborative health care teams for various obesity intervention models by composing and delivering the nutrition components (Collins et al., 2007).

While adolescent obesity interventions have been reported (McClaskey, 2010; Power et al., 2010) and intervention personnel, including RDNs, have been identified (Collins et al., 2007; Hollar et al., 2010), the role of the intervention personnel and the impact those personnel on outcomes in adolescent obesity interventions have not been previously studied.

Specifically, adolescents' perceived benefits of having registered dietitian nutritionists involved in an adolescent obesity intervention have not been studied. Information on adolescents' perceptions regarding the role of the RDNs can aid in developing successful adolescent obesity intervention programs (Wilson, 2007), as well as enhance the role of RDNs in obesity interventions and prevention. Therefore, the purpose of this study was to identify adolescents' perceptions regarding the usefulness and benefit of registered dietitian nutritionists in an adolescent obesity intervention: Wellness Incentive to Health (WITH) program.

Methods

To gather adolescents' perceptions of the usefulness of RDNs in an obesity intervention, qualitative methodology using one-on-one in-depth interviews were implemented. As part of a follow up study to an adolescent obesity intervention program, adolescents who completed the program were invited to participate. Use of one-on-one interviews allowed for in depth participant responses to elicit a greater understanding of adolescents' perceptions of the role and benefits of RDNs in the obesity intervention. Interviews were conducted until data reached saturation (Guest, Bunce, & Johnson, 2006) and the University of Idaho Institutional Review Board (IRB) granted approval for the study.

Wellness Incentive to Health (WITH) Adolescent Obesity Intervention

Prior to this study, the WITH pilot study was conducted in the spring of 2012 to measure the feasibility and effects of a new interdisciplinary program for overweight and obese teenagers in Northern Idaho. Twenty participants were enrolled in the 12-week WITH program. Weekly educational and motivational mentoring sessions were provided by

the following individuals: physical therapy assistant/personal trainer, registered dietitian nutritionists, registered nurses, health science students, and volunteers. Details about the program and results have been published elsewhere (Ramsay et al., 2013).

Subjects and Setting

Two weeks after completing the WITH intervention, adolescents were ranked based on their participation in the program. Adolescents who had the highest attendance rates in the WITH program were contacted via phone and asked whether they wanted to participate in a follow-up one-on-one interview regarding their perceptions of the RDNs and nutrition component. Adolescents continued to be contacted via phone until data reached saturation (Guest et al., 2006). The original WITH inclusion criteria was Body Mass Index (BMI) above the 85th percentile for their age, and enrollment in grades 10-12 at one of the local high schools. Current weight and height assessments were not gathered for follow-up one-on-one interviews to prevent emphasis on continued weight change and to keep the focus of the interviews on adolescents' perceptions related to their experiences in the nutrition component. If participants agreed to the interview, they were asked to meet with the primary researcher at a time and location convenient for them. At the beginning of the interview, parental consent and participant assent were obtained (see Appendix A). After completing the interview, participants received a twenty dollar gift card to a local grocery store as compensation for their time.

One-on-One Interview Procedures

One-on-one interview procedures followed protocol guidelines of Miles and Huberman (1994). An interview questionnaire guide (see Appendix B) was developed and reviewed by a childhood obesity expert. Questions asked participants about their knowledge

of RDNs, the benefits of having RDNs in the WITH program, and what they learned from the RDNs in the WITH program. For example, questions asked were, "What was your knowledge of registered dietitian nutritionists *before* participating in the program?;" "What is the benefit of having registered dietitian nutritionists involved in the program?;" "What nutrition information did you learn during the program that you will continue to use?" Probing questions were asked as needed to gather in-depth and detailed information. For example, when a participant was asked about nutrition information he or she learned during the program that he or she will continue to use, the response was, "Balanced diets." The follow-up question, or probe, was, "Explain what you mean by balanced diets." Participant interviews lasted approximately 30 minutes, were audio-recorded, and transcribed.

Data Analysis

Transcriptions were systematically coded and analyzed by the researcher to identify central themes, following the guidelines of Miles and Huberman (1994). The text was read and re-read multiple times to confirm and verify codes and themes. Data analysis consisted of data reduction, data display, and conclusion drawing and verification. The purpose of data reduction was to condense the text and focus on terms addressed by participants. This process required multiple reviews for verification. After data reduction, terms were categorized and labels were given to the text for data display. The labels and categorizations were then grouped into themes. Once data was organized and themes identified, identification of connections between themes and meta-themes emerged that assisted in the process of forming conclusions. Multiple reviews of the text, codes, and themes occurred at each step of the data analysis process to confirm codes, themes, and meta-themes. All procedures in the data analysis were reviewed by a child obesity expert.

Results and Discussion

Demographics

Ten adolescents, between 15-17 years of age, completed the one-on-one interviews. Four adolescents stated they were involved in organized sports: volleyball, track, La Crosse, and football. Two of the four adolescents participating in sports were involved in two sports each. Eight adolescents stated that both parents worked, while one adolescent reported only her mom works and another said only her father works. Two participants reported asthma as an existing medical condition. Demographic information is presented in Table 1. Adolescents reported their perceptions regarding the WITH program, the nutrition component, and specifically, the RDNs' involvement in delivering the nutrition component.

Table 1. Demographics of Study Participants

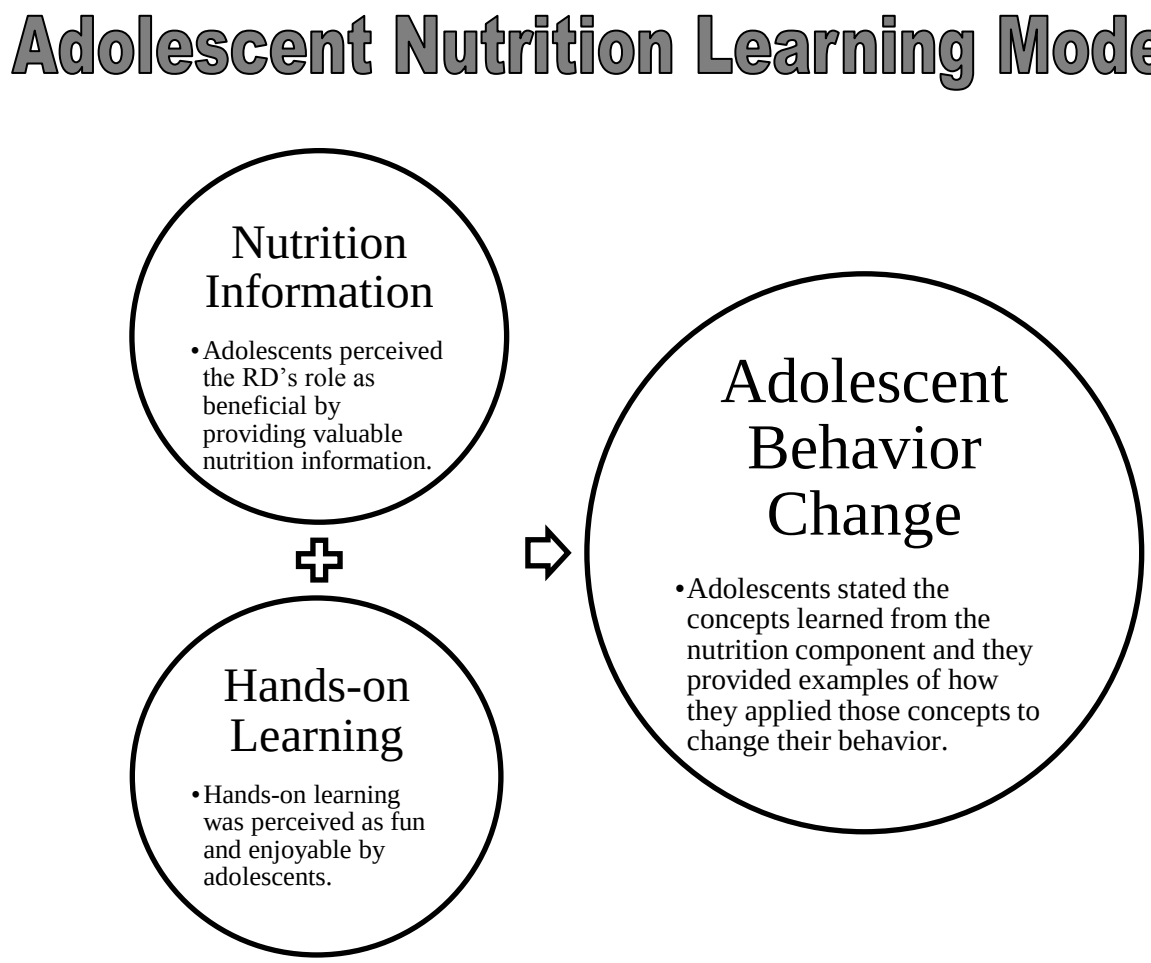
Characteristics of Study Participants	**N=10**	**%**
Gender		
Male	2	(20)
Female	8	(80)
Age		
15	1	(10)
16	5	(50)
17	4	(40)
Year in School		
10^{th}	6	(60)
11^{th}	4	(40)

Race		
American Indian/Alaskan Native	1	(10)
White	8	(80)
Other	1	(10)
Involvement in Organized Sports		
Yes	4	(40)
No	6	(60)
Marital Status of Parents		
Married	6	(60)
Divorced	3	(30)
Separated	1	(10)

Adolescent Nutrition Learning

Four overarching themes emerged from the interview data. Three are depicted in the Adolescent Nutrition Learning Model (see figure 1). The four themes included (1) adolescents perceived the RDNs' role as beneficial by providing valuable nutrition information; (2) hands-on learning provided by RDNs was perceived as fun and enjoyable; (3) adolescents recalled concepts learned from the nutrition component and they provided examples of how they applied those concepts to change their behavior; and (4) adolescents reported they disliked logging their food intake and entering their food diary online.

Figure 1. Conceptual Model



Nutrition information. *Nutrition Information* is the first piece of the Adolescent Nutrition Learning Model (see figure 1), which lays a foundation for nutrition knowledge adolescents learned from the RDNs. Adolescents described the RDNs' role as beneficial because they perceived the RDNs as providing valuable nutrition information. The recognition of the RDN as a nutrition expert has been previously identified (Hollar et al., 2010; Lichtenstein, 2007; Rhea & Bettles, 2012). However, prior to the WITH program, nine out of ten adolescents proclaimed to have no knowledge of RDNs or what RDNs do.

These results reinforce previous findings about lack of knowledge of the RDN professional and expertise of the RDN in health care (Academy of Nutrition and Dietetics, 2013).

After completing the WITH program, adolescents stated multiple examples of the benefit of RDNs in an adolescent obesity intervention. Specifically, they stated RDNs possess valuable nutrition knowledge and he/she can use this knowledge to effectively teach adolescents about proper nutrition, as reported in previous research (American Dietetic Association, 2006a; Lichtenstein, 2007). Adolescents identified RDNs as the *food* experts; health professionals who provided nutrition recommendations based on *individual* needs, and as mentors that were *supportive and non-judgmental*. Each of these beneficial roles will be described below. For additional comments describing benefits of RDNs in an adolescent obesity intervention, refer to table 2.

Adolescents described RDNs as the *food* experts. Registered dietitian nutritionists have the knowledge about the composition of food to include how food affects the body, and why food is healthy (benefits of specific food). For example, one adolescent stated:

> When it came to nutrition, the RDNs were the best it could get for needing help with nutrition or what not . . . the RDNs knew, like the science of food, the weird things that I've learned that the RDNs would tell us.

Another adolescent stated:

> I just like how the [nutrition] classes were taught. I thought they were really good because rather than saying, 'oh, this food is good,' the RDNs went into depth and showed us why [food is] good and how [food] can help us and I think that helped a lot because getting healthy, eating better, is a big part of it [getting healthy].

These statements support previous literature that RDNs are recognized as nutrition experts and they use their expertise in prevention and treatment of obesity (Kushner & Neff, 2010).

Adolescents also noted RDNs had nutrition information about how to cook healthy recipes, how to read food labels, and how to recognize appropriate portion sizes, as cited in previous research (American Dietetic Association, 2006a; Lichtenstein, 2007). For example, one adolescent stated, "RDNs know every single thing on food labels and you're like the deepest it gets into the food world, pretty much, knowing about the food." Another participant reported, "RDNs explain to you what's in foods and how to read a food label and serving sizes."

Another beneficial role of RDNs reported by the adolescents was having RDNs who made nutrition recommendations based on *individual* needs. Registered dietitian nutritionists can provide one-on-one consultations to give individualized nutrition recommendations (American Dietetic Association, 2006a; Díaz et al., 2010). These same services are valued by adolescents and were identified as a benefit to help them meet their goals to improve healthy eating habits. The value of having individualized care is demonstrated in one adolescent's statement, "I just learned about my health and my body type. I figured you guys were just going to tell us as a whole, not like individually. You gave us our own nutrition things [recommendations]!" Adolescents identified the benefits of RDNs as providing individualized tips appropriate for adolescents to make small changes that lead to healthier habits, which has been demonstrated in previous literature (Flattum et al., 2011; Prochaska et al., 1992; Walpole et al., 2011). A preference for adapting educational strategies for adolescents is demonstrated in one adolescent's comment:

> I like how [RDNs] do know how to eat healthy, but they also know different ways to share it and they know how to talk to teenagers. They know how to make it knowledgeable for them. They know how to give different ways for them to learn. Not just "here's healthy food."

This desire for a more tailored learning style when working with adolescents supports previous research (Casazza & Ciccazzo, 2007).

The final beneficial role of the RDNs in providing nutrition information was the value of having RDNs deliver information in a *supportive and non-judgmental* manner. The RDNs served as mentors in the program and were perceived as *supportive and non-judgmental* as demonstrated by one adolescent's comment, "They [RDNs] were really supportive and they really cared about your well-being and not just about seeing if this program worked or not." Adolescents stated how the RDNs held them accountable by being organized and keeping them on task throughout the WITH program. These results support previous research that adolescents desire a supportive environment to keep them motivated to learn (Jelalian et al., 2011).

During the first part of the Adolescent Learning Model, adolescents perceived RDNs as nutrition experts providing valuable nutrition information. Not only did adolescents perceive expertise of the RDNs as valuable for nutrition information, but also the delivery of nutrition information was in a manner conducive to adolescents' learning style (Casazza & Ciccazzo, 2007). Providing nutrition information tailored to the adolescent learning style was captured in the next piece of the Adolescent Nutrition Learning Model.

Hands-on learning. *Hands-on learning* is the second element of the Adolescent Nutrition Learning Model (see figure 1). The RDNs provided valuable nutrition information

through *hands-on learning* activities that adolescents found fun and enjoyable. Four aspects of hands-on activities were identified by the adolescents as fun and enjoyable: (1) learning about nutrition in an *experiential classroom*; (2) learning from *visual* aids that guided nutrition information; (3) *tasting/trying* new foods; and (4) *working in groups*. See table 2 to view more adolescents' responses in addition to what is identified below.

The first aspect adolescents described in regards to why they found these activities fun and enjoyable was the variety of activities in an *experiential classroom*. Activities learned in an experiential classroom enabled adolescents to learn how to make healthy choices in real-life settings, and gave them control to do so, a learning principle previously identified (Contento et al., 2010; Daniels et al., 2005). The use of activities in an experiential classroom was described by one adolescent, "Not just 'here's healthy food.' [RDNs] actually show, like when the RDNs took us out to a restaurant and showed us what good choices to get and I think that's good." Another adolescent described her favorite part of the program and the value of learning how to translate the information to a real setting:

> . . . the cooking one where we cooked ourselves and we went to Red Robin®. It was a whole different perspective rather than just doing it myself at home. I was going out and trying to figure out what was good for me.

Another expressed a similar response: ". . . that [Red Robin®] was a fun class because it really did show you how to make better choices."

One experiential activity was an end-of-year BBQ. Adolescents described how they enjoyed the end-of-the-year BBQ because it gave them an opportunity to use skills they learned from the classes in a real-life social setting. One adolescent described her realization that a BBQ could be healthy:

> I really liked the BBQ at the end of the summer . . . just altogether eating healthy and we played baseball and it didn't even seem weird . . . We were eating veggie burgers and stuff and it didn't even seem weird to us.

These findings support the idea about hands-on activities being crucial for prompting behavior change. Previous literature cited a need for adolescents to employ control and make their own decisions to reinforce autonomous motivation according to the self-determination theory (Contento et al., 2010).

A second aspect to hands-on learning activities adolescents enjoyed was having *visuals* available to help guide information presented. Examples used in the program include the MyPlate (U.S. Department of Agriculture, 2013) visual to show food groups and portion sizes; and the Bodybugg®, an electronic wearable device that showed calories burned and steps taken along with graphs and charts. Visual aids used during *hands-on learning* activities in nutrition education, as cited in previous research (Evans, Daly, Hopkins, Davies, & MacDonald, 2009), are most effective in initiating positive behavior changes. One adolescent explained how the visual of MyPlate helped:

> I learned about MyPlate, like what [food groups] we need to get . . . but not too much of it because even if we think, 'oh, this is healthy,' we can't eat a bunch of it because that's still not good . . . I think I need the picture, maybe print the picture [of MyPlate] so I know.

Another adolescent exclaimed how he liked the visual of the Bodybugg®, "It was nice to see how many steps I took and the calories I lost and stuff like that. That was cool!" Seeing improvements in health tests taken before and after the program was valued by one student

as demonstrated in her statement, ". . . when we did the lipid tests . . . seeing those results from the time I started and time the program ended was pretty cool."

Another aspect of hands-on learning activities adolescents perceived as fun and enjoyable was *tasting/trying* new food during nutrition classes. As described in previous research, exposure to new foods such as fruits and vegetables leads to an increased consumption of those foods (Añez et al., 2013; Evans et al., 2012; Heim, Stang, & Ireland, 2009; Perikkou, Gavrieli, Kougioufa, Tzirkali, & Yannakoulia, 2013). Opportunities to taste and try new foods in the nutrition class increased adolescents' willingness to try and eat those foods. For example, adolescents stated, "I was so used to certain foods. I explored with different foods a lot more in the program" and, "I think I tried ten new vegetables or something like that. . . I really like the peppers and the broccoli [surprised to like them]!" One adolescent was pleasantly surprised about the hands-on activities: "I didn't think we were going to have hands-on cooking and hands-on tasting! I remember when we did the milk [creamier skim milk]. That was cool!"

A fourth aspect adolescents enjoyed about hands-on learning activities was *working in groups*. *Working in* groups was appreciated because it reinforced a social learning environment, reinforced a supportive environment, and reinforced adolescents' motivation to participate. In this study, the opportunity to interact with peers and friends reinforced a social learning environment valued by the adolescents. This supports previous research that adolescents are more willing to participate in group settings to fill their natural needs to socialize (Wilson, 2007). The value of a social learning environment is demonstrated by one adolescent's comment, "All my friends were there and we were learning about new food

and that was what I was excited to do: learn about nutrition, and it wasn't boring so that's good."

Adolescents stated how being with peers and friends resulted in a supportive environment, which has been previously described that peers may act as positive support for each other while undergoing changes in healthy behaviors (Jelalian et al., 2011). One participant expressed how she liked working in a group setting for the benefit of having a supportive environment in her statement:

> I think it was nice knowing you had a group behind you . . . you know, just the whole group part of it. It's not like you just had you and one person telling you what you needed to do. You had mentors. You had friends in it. . .

Adolescents described working in groups as motivating and kept them on track with tasks. One adolescent stated, "I think just being in a group of people that want to find a difference in themselves was super motivating." Adolescents are more willing to engage in activities when their peers are involved because the activities may be deemed as acceptable and "cool" (Utter et al., 2010), and thus more motivating. Adolescents provided numerous responses demonstrating the motivation to working in groups. One participant noted the nutrition activities were his favorite part of the program "because, well, you got our whole group together, which was really fun." Another adolescent said, "I was excited to do all the activities and work with other people my age," while another exclaimed, "It was just a fun time to be there with friends and learn about how to eat healthy and actually was given visuals and tasted foods so that was better."

Adolescent behavior change. Adolescent behavior change is the final outcome in the Adolescent Nutrition Learning Model. Adolescents reported concepts learned from the

nutrition component and provided examples of how they applied the concepts. Such change in behavior is a measure of self-efficacy previously recognized in nutrition education (Contento et al., 2010; Walpole et al., 2011). Concepts adolescents stated they learned include (1) adding a variety of foods to their diet; (2) how to make healthy choices while eating out with friends or when traveling; (3) how to incorporate nutrition principles, i.e. recognize appropriate portion sizes, make small dietary changes, and recognize internal cues; (4) how to read nutrition labels at the supermarket; and (5) how information learned from the WITH program made a difference to others around them (i.e. family and friends). Table 2 provides examples stated by participants in addition to what is stated below.

One behavior change adolescents demonstrated was *learning about and adding a variety of foods to their diet* after participating in hands-on activities such as tasting and trying new foods (Añez et al., 2013; Evans et al., 2012; Heim, Stang, & Ireland, 2009). One adolescent described how he learned to add more food groups in his diet:

> Balanced diets. I definitely like eating more balanced. I've lost a lot of weight, actually. I'm stoked . . . I used to eat just meat every night, that's it, for dinner. I was eating meat with bread or something like that . . .I liked [having an RD in the program] a lot. It helped me. I didn't know what to eat before and I didn't know what I should be eating and how I should be eating it. I never [knew I] had to have fruits and vegetables. I didn't know that I was supposed to eat carbs and stuff, too. I thought, 'no carb diet.' Things like that. I didn't know I was supposed to have variety.

The adolescent described how he learned to distinguish between evidence-based nutrition information from popular fad diets. This distinction allowed him to choose and consume a

variety of foods. The results reinforce previous research about adolescents needing assistance differentiating between popular fad diets and accurate evidence-based nutrition information (Lichtenstein, 2007). Another adolescent expressed his newfound awareness of other healthy choices he can add to his current diet:

> Overall, what I learned from the program was a whole different outlook on food . . . The biggest thing I've learned was adding more variety of foods to my diet . . . Before I was eating veggies, chicken, you know . . . just plain and clean stuff . . . but because of the WITH program, and the RDNs, I know there's a variety of food out there that I can try and different stuff.

These statements illustrate how the adolescents learned to add a variety to their diets after participating in the nutrition component of the WITH intervention.

A second behavior change was *adolescents were able to make healthier choices when eating out with friends or when traveling:* Adolescents reported that the Red Robin® class taught them skills they used in real life situations, demonstrating that hands-on activities enhanced their self-efficacy in making their own decisions to improve healthy habits (Contento et al., 2010; Walpole et al., 2011). One adolescent's comment demonstrates about how it allowed her to hang out with her friends, "I learned to make better choices and meeting other people half way; so not secluding myself from everyone else. So if we went out to dinner, I can make my own decisions." Another adolescent described how she applied her learned skills when traveling:

> [Like] Red Robin® or like just going out places and using what we learned in real life situations . . . Like when I went to L.A. When we ate we had to eat at airports and stuff, but I knew the choices I could eat that I didn't know about before.

Adolescents applied nutrition principles i.e. recognize appropriate portion sizes, how to make small changes that could lead to healthier outcomes, and how to recognize internal cues to demonstrate their behavior change. Nutrition education should address appropriate portion sizes, especially with low quality energy-dense food, and provide strategies on how to control portions (Ledikwe et al., 2005). One adolescent expressed adding food groups such as fruits and vegetables and is eating appropriate portion sizes: "[I incorporated the nutrition] just the portion sizes and balanced diets and putting those fruits and vegetables in with your meals." Another adolescent reported avoiding the expectation to clean her plate, a means to recognize her internal cues: "Healthy portion sizes [describing what she follows] and you don't have to eat everything on your plate. When you're full you can just be done with it."

Adolescents stated they made small changes that lead to healthier outcomes without "going on a diet." Adolescents expressed that they were happy the RDNs in the WITH program did not put them "on a diet." This practice by the RDNs reinforces that RDNs take a total diet approach and that all foods fit in moderation (Freeland-Graves & Nitzke, 2013). Instead, adolescents were glad to know that making small changes in their dietary habits could lead to healthier outcomes without sacrificing food they enjoy. One adolescent described small changes with ingredient substitutions that can make a dish healthier without having to give up the dish entirely, "You can change other ingredients to make it healthier and you don't have to . . . just alternative stuff." These statements by adolescents are supported by research about adolescents' willingness to make small changes, like adding fruits and vegetables, but not wanting to sacrifice other foods deemed unhealthy, such as soda and chips (Wilson, 2007). Making small changes is more feasible and provides

motivation for adapting of healthy behaviors (Kapsak, Smith Edge, White, Childs, & Geiger, 2013).

The fourth behavior change demonstrated by the adolescents was an ability to *read nutrition labels at the supermarket:* Adolescents were able to apply knowledge of how to read a food label after attending the supermarket class. Statements made by participants supports previous research about adolescents needing education on how to read a nutrition label (Demory-Luce, 2005). One adolescent stated reading nutrition labels to differentiate between different types of oils:

> I liked the oils, different kinds of oils, and we looked at the nutrition on the back of it. Then my dad and me went to Albertson's right after [the fats and fiber class] . . . I told him about the oils and he was like, "Let's go look at the oils!

Another adolescent reported having no knowledge when it came to reading food labels prior to participating in the nutrition component of the WITH program:

> [What I liked about having an RDN involved in the program was] I didn't know how to read a food label so that way [now] I know how to read a food label and I know exactly what is in something before I eat it, so it has really helped me when I was exercising to know maybe I shouldn't eat that.

The final behavior change adolescents described was application of *what they learned from the WITH program made a difference to others around them (i.e. family and friends):* Adolescents took their new knowledge and skills from the WITH program and shared it with friends and family to change the behavior of those around them, a phenomena previously identified (Falba & Sindelar, 2008). In her statement, one adolescent talked about how knowledge learned made a difference in her family and with her friends, "It was

very important to have the nutrition component. And it didn't just change you. It changed anyone else around you [referring to friends and family]."

Adolescents reported they disliked logging their food intake and entering their food diary online. The one dislike adolescents discussed in interviews was the difficulty logging their food intake and entering food into the online Bodybugg® program (see table 2 for additional statements by adolescents). As a result, adolescents in the study may not have utilized this activity on the Bodybugg® website. They described the process of keeping track of foods they ate and customizing their meal plan as difficult as well as time consuming. While the challenge with maintaining food logs has been previously noted (Acharya, Elci, Sereika, Styn, & Burke, 2011; Burke et al., 2005; O'Loughlin et al., 2013), limited research is available about adolescents' opinions on keeping food diaries or logging food intake into a computer program. One adolescent expressed her frustration with keeping a food log stating, ". . . having to write what you ate because it was difficult. I don't think I ever did it. It was too difficult. . . It was super time consuming" and another adolescent commented, "Food logging, just cuz I couldn't be around the computer all the time and it was kind of hard to keep track sometimes to write everything down because you don't think about it all the time." One adolescent expressed difficulty in trying to customize meals in the Bodybugg® as demonstrated in her comment:

> When you tried to put in different stuff (referring to food), it didn't have it or it didn't have what you wanted to put in there . . . and I tried to do some customizing and then you couldn't get to it every day so it was kind of hard.

Table 2. Adolescents' Perceptions of the RDNs and Nutrition Component

Themes and Sub-themes	Exemplars
Nutrition Information: **Adolescents perceived the RDN's role as beneficial by providing valuable nutrition information.** Registered dietitian nutritionists were perceived as beneficial by adolescents in an adolescent obesity intervention. Registered dietitian nutritionists were perceived by adolescents as the food experts who have valuable nutrition knowledge.	"The RDNs were more relatable . . . cuz you could ask them about anything." "I liked when the RDNs gave the paper on telling us what we should be eating for each individual person for our body type. I liked that." "Registered dietitian nutritionists can explain how the things (food) work and why this is like that." "Registered dietitian nutritionists know healthier alternatives and RDNs know what is better for you and your body." "Registered dietitian nutritionists know more about what different foods do for the body and how they affect people." "Well, anyone can be like, 'okay, this is healthy,' but [RDNs] know *why* it's good for you . . . It's just nice to know what's the best for you and what the benefits are."
Hands-On learning was perceived as fun and enjoyable by adolescents. Adolescents enjoyed participating in hands-on learning activities. Aspects of hands-on learning activities adolescents identified as fun and enjoyable.	"I never knew there was a different kind of premium skim milk or something like that. I never knew about that." "I was so used to certain foods. I explored with different foods a lot more in the program." "I liked everything that [involved] a group." "I was happy when I learned we were going to do all this fun stuff and I had friends that were doing it." "Everyone that was in the group, the WITH group, was really supportive of everybody." "They took my blood test and said everything was better. Like the bad levels were lower and the good ones were higher (cholesterol). It was good." "I thought this was rather simple [nutrition component] because you didn't have us start a diet or something." "I like the Bodybugg® and how it counted your calories burned, your steps. I thought it was cool it could do that, and how you could just plug it into the computer and it would show you graphs and everything."

Adolescents reported concepts learned and provided examples of how they applied the concepts.	"I learned about the MyPlate, like what we need to get, certain things for meals like grains and dairy and stuff." "[The WITH program] introduced me to a lot more variety of food. When I stared going to the nutrition classes, I started learning more and more things. I started gaining more knowledge about different foods that are out there that I could have." "[I Learned about nutrition] just the portion sizes and balanced diets and putting those fruits and vegetables in with your meals." "I look at what I'm eating more and try to get a variety of foods more than I did before." "[I learned] to just make healthier choices, like when you go out to a steak house, instead of getting steak and a potato, you could get a steak and a salad." "It made me realize portion sizes and what I should be eating and what I shouldn't be eating." "[I learned about] portions, but what also helped me is that I measured out stuff and I did a little bit and I'd eat it." "I learned about the nutrition things like portion sizes, things like new fruits I hadn't eaten before." "I now know what I need to be doing to get healthier and it's become easier, not a chore, but a lifestyle change." "I learned that there's much healthier *alternatives*, but they are fine, and how to just change everything I've been doing pretty much." ". . . ever since we were little, you how they'll like, 'You can't leave the table til you clean off your plate' so you kind of grow up in this place where you fill up your plate and then you supposed to eat it all. So I think that's what helped, too, cuz I noticed it was like, 'I don't have to eat all this until I'm full or tired.'" "I didn't a lot about nutrition, like how to read a nutrition label and now I do." "My mom used butter to cook with everything. And then we started using different things, like different oils and stuff like that." "And even my aunt, she did this diet, like no carbs or anything and it was really hard on her and so we

	showed her different things that she could do so she didn't have to cut out everything and she still lost a bunch of weight, but she said it wasn't painful. It wasn't as hard."
Adolescents reported they disliked logging their food intake and entering their food diary online. • Adolescents perceived entering food into Bodybugg® as time consuming. • Adolescents felt it was difficult to enter food into the program. • Adolescents stated that it was difficult to keep track of foods throughout the day. • Adolescents reported that it was difficult to customize their meals in Bodybugg®.	"It was kind of hard to plug in all the information in the diary." "It (the Bodybugg®) was kind of complicated, especially in the area of the nutrition and logging in online."

Summary

While there has been previous research on what activities and components adolescents want in obesity interventions (Wilson, 2007), there is no known research on their perceptions of the personnel (RDNs) delivering components. This study addressed this gap. Adolescents stated their perceptions of the RDNs' role in an adolescent obesity intervention (WITH), as well as their perceptions of the nutrition component. Adolescents identified RDNs as food experts because of their in-depth knowledge of nutrition. Adolescents learned *nutrition information* from the RDNs and reported enjoying how RDNs delivered nutrition information with *hands-on* activities. Adolescents gave examples of how they *applied the concepts learned* in the WITH program, and they demonstrated *behavior change*, which is outlined in the Adolescent Nutrition Learning Model (see figure 1).

This study has a few limitations. A small convenience sample composed of adolescents from one high school in one geographical area and who were primarily

Caucasian, participated in the study. However, the purpose of this study was to determine adolescents' perceptions regarding the usefulness of RDNs in an adolescent obesity intervention program and all participants had attended the program. Participants' attendance in the nutrition component varied; however, all participants attended a minimum of six activities in the WITH program. The participant sample did not have equal representation of males and females, but previous research has shown females to have higher participation rates in childhood and adolescent obesity interventions (Moore et al., 2009; Porter & Pelletier, 2012; Robbins et al., 2012; Stice et al., 2006) which is consistent with the current study.

Implications for Practice

Adolescents in this study identified benefits of RDNs and the nutrition component as part of an adolescent obesity intervention. Considering adolescents' perceptions of personnel and activities when designing adolescent obesity interventions is important (Wilson, 2007). Tailoring interventions for adolescents is necessary to meet needs of the adolescent population (Collins et al., 2007; Hollar et al., 2010; Lichtenstein, 2007; Rhea & Bettles, 2012). In this study, adolescents identified having RDNs with nutrition expertise as beneficial in delivering hands-on learning activities. Experiential classroom settings incorporating a hands-on approach gave adolescents knowledge and skills necessary to make positive behavior changes. Registered dietitian nutritionists and other health professionals may consider using the Adolescent Nutrition Learning Model for future adolescent obesity interventions as well as adolescent nutrition education. Although adolescents' perceptions of logging food into the online food diary were not the focus of this study, it was an important theme that emerged when asking about their perceptions of the nutrition

component. Adolescents reported they disliked logging food into the online food diary, citing that it was too difficult and time consuming. Further research is needed to address barriers associated with food logging in the adolescent population.

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Appendix A

Research Study Consent/Assent Form

Addendum for Project 12-060

Wellness Incentive to Health (WITH) Pilot Study- Effects of a 12-week community collaborative program for teenagers at high risk for health impacts of obesity

Participants who participated in the WITH pilot study and completed a minimum of 15 program activities (n=12) will be contacted on whether they would be interested in participating in a post intervention interview. Each participant will be contacted and asked whether they would be willing to meet at the UI CDA Center for a 30-45 minute interview that will be audio recorded. The purpose of the interviews is to gather feedback from participants about the nutrition component of the study. Parental consent and participant assent will be obtained (See consent forms below.) There will be a $20 Fred Meyer gift card compensation for participating in the interviews. Interview questions will be asked about the program, the role of the dietitian, and the nutrition education classes (See interview questions in the attached document.)

Research Study Consent/Assent Form

Study Title: Wellness Incentive to Health (W.I.T.H.) Post Intervention Interviews – Effects of a 12-week community collaborative program for teenagers at high-risk for health impacts of obesity

Researchers:
Primary Investigators

Co-Investigator Samantha Ramsay, PhD, RD, LD
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Clinical Research Coordinator
Kootenai Health Nursing Administration Department
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Sponsor: Blue Cross of Idaho Foundation for Health, Inc.

Your child is being asked to take part in a post intervention interview to learn about how the intervention influenced their nutritional health. This study is being led by the team listed above in partnership with the Kootenai Medical Center and the University of Idaho. Before you give your consent (parental permission) and your child gives assent (agreement) to take part, you should both carefully read the following information. It explains the post intervention interviews. Ask the researcher to explain anything you don't understand.

You are making a decision whether or not your child will participate in this post intervention interview. If your child joins the study, you or your child can change your minds later and decide against participating at any time. There will be no penalty if you or your child decides not to take part in the study or quit later. This study has been approved for human subject participation by the Kootenai Health Institutional Review Board and the University of Idaho Institutional Review Board.

What will my child be asked to do if he or she is in this post intervention study?

If you decide you want your child to be in this study and he or she agrees, you will both be asked to sign this form. Your child will be asked to attend a 30-45 minute interview to be scheduled at the UI CDA Harbor at a convenient time for you or your child. An interviewer will ask questions about the program, the nutrition consultation and education classes, and the use of a dietitian in the program.

Will my child's information be kept private?

The data for this study will be kept confidential to the extent allowed by federal and state law. No published results will identify you or your child and your names will not be associated with the findings. The results of this study may be published or presented at professional meetings, but the identities of all research participants will remain anonymous. Under certain circumstances, such as inspections for research quality, information that identifies your child may be released for internal and external reviews of this project as required by law.

We will not store any identifying information like last names or social security numbers with our data file. Your consent will be kept separate and in a locked file. Your child will be given a code number to use for any program forms or web-site activity to protect privacy.

The data for this study will be kept for five years after completion of the study and then destroyed. Depending on the study findings, it is possible that researchers will want to follow up with participants to see if the program has lasting effects. If so, you will be asked to sign another request that allows researchers to keep your child's data longer and contact your child in the future.

Your child will receive a $20 Fred Meyer gift card in compensation for taking part in the interviews.

Who can I talk to if I have questions?

If you or your child have questions about this study or the information in this form, please contact the primary researcher:
Primary Investigator Samantha Ramsay, PhD, RD, LD
Assistant Professor University of Idaho
208-885-6026 sramsay@uidaho.edu

If you have questions about your child's rights as a research participant, or would like to report a concern or complaint about this study, please contact the Kootenai Health Institutional Review Board by calling the administration at 208-666-2001 from 8:00 a.m. to 4:30 p.m. Monday through Friday.

The results from the study will be available and participants may request them from members of the research team once the study is completed.

What does my consent and my child's agreement for assenting mean?

If you both complete and submit this form it means that:

- You both understand the information given to you in this form
- You both have had the chance to ask the researcher questions and state any concerns
- The researcher has responded to your questions and concerns
- You both believe you understand the research study and the potential benefits and risks that are involved.

To be in this study, you both must sign this form.

I have read (or been read) and understand the information provided above describing the research study. My questions have been answered and I have signed this form in agreement to participate in this study. I will receive a signed and dated copy of this consent/assent.

_____

Name of Participant (print) / Print your name here if you agree to participate in the study (assent)

_____ _____

Signature of Participant/ Sign your name here Date

_____ _____

Name of Parent 1 or Legal Guardian (print)/Print **Relationship to Subject**

_____ _____

Signature of Parent 1 or Legal Guardian/Sign **Date**
your name here if you agree your child may participate in the study (consent)

_____

Name of Person Obtaining Consent/Assent (Investigator or Designee) (print)

_____ _____

Signature of Person Obtaining Consent/Assent Date
(Investigator or Designee)

Appendix B

Wellness Incentive to Health Interview Questionnaire Guide

Wellness Incentive to Health Interview Questionnaire Guide

Name: _____

Gender**:** M F

Age: _____

Year in School: _____

Are you involved in organized sports? Y N If so, what type? - _____

Marital status of parents: Married Divorced

Which of your parents work? Mom Dad Both Neither

1. What did you think the program would be like?

2. What was your knowledge of registered dietitian nutritionists *before* participating in the program?

3. After you started the program, what were your first impressions?
    a. First impressions of evaluations?
    b. First impressions of fitness component?
    c. First impressions of mentors?
    d. First impressions of nutrition component?

4. How has participating in the WITH study effected your health?

5. What was your favorite part of the program?
    a. Why?

6. What was your least favorite part of the program?
    a. Why?

7. What did you learn from participating in the program?
    a. What did you learn about nutrition?

8. What nutrition information did you want more of during the program?
    a. Was there any nutrition information that wasn't discussed that you hoped would be?

9. What is your current knowledge of registered dietitian nutritionists *after* participating in the program?

10. What is the benefit of having registered dietitian nutritionists involved in the program?
    a. Was there anything in particular that you like about having an RD in the program?

11. Please describe your experience with the BodyBugg® (likes and dislikes).

12. What nutrition information did you learn during the program that you will continue to use?

13. How important was it for your success to have had the nutrition component of the WITH program?

14. Additional comments regarding the program and the involvement of registered dietitian nutritionists.