A Program to Promote Physical Activity and Healthy Body Weight in an Adolescent

Female: A Case Study

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Abstract

A case study of an obese 14-year-old female was conducted to assess her body weight and dietary and physical activity habits. The purpose of this study was to promote weight loss through improved dietary practices and an increase in energy expenditure. This was done by monitoring and altering caloric intake and engaging in regular, vigorous physical activity. Furthermore, the subject increased health-related knowledge, developed new skills, and ultimately attempted behavior modification. From April to September 2009, the subject participated in a minimum of two supervised exercise sessions per week to increase her energy expenditure and to teach her strategies for exercising independently on a regular basis. Further, she was given personalized dietary strategies to promote weight loss and healthy weight management. Anthropometric, cardiovascular fitness, muscular strength and endurance, flexibility, and resting metabolic rate assessments were conducted at regular intervals. Baseline assessments were performed in early April, and mid-program measurements were taken in early June. Post-testing was conducted in September to evaluate the subject's final measurements and assess her ability to maintain healthy habits, while transitioning from a more structured schedule during the school year to one with more leisure time during her summer break. The subject increased health behaviors from baseline to mid-program testing, but regressed between mid- and post-program assessments. Results reflected these patterns.

Keywords: adolescent, overweight, obesity, nutrition, physical activity, weight loss, behavior modification

Chapter I-

Introduction to Problem of Adolescent Overweight

<u>Introduction</u>

Adolescent overweight and obesity has increased dramatically in the United States in the past two decades. Odgen, Carroll, Curtin, Lamb, and Flegal found, "Since 1980, the prevalence of BMI-for-age at or above the 95th percentile (sometimes termed "obese") has tripled among school-age children and adolescents, and it remains high at approximately 17%" (Odgen et al., 2010). This prevalence is alarming as there are immediate, as well as long-term, negative health effects associated with overweight and obesity. These include, but are not limited to, hypertension, heart disease, and Type 2 diabetes mellitus, some cancers, as well as emotional disorders. Although BMI does not directly measure body composition, a high BMI for children is correlated with adiposity, and thus negative health consequences. Even more, a teenager who is overweight or obese is more likely to be overweight or obese as an adult, which puts them at greater risk for the aforementioned co-morbidities associated with overweight and obesity. Trends in adolescents have not declined over the past 2 decades, and American adolescents have become heavier. There is a high need for these trends to be reversed in order to protect the health of our youth.

Statement of Purpose

The purpose of this study was to improve the subject's dietary practices by monitoring and altering her caloric intake where necessary and to promote the adoption of healthy, lifelong physical activity through the development of skills, knowledge, and behavior.

Delimitations

The study was delimited to the following:

The subject for this case study was a 14-year old female who self-selected herself into the study.

- The study took place in Atascadero, CA with fitness assessments conducted at the Human
 Performance Laboratory at Cal Poly State University in San Luis Obispo, CA.
- The intervention lasted 24 weeks.
- The subject did not attend all scheduled training sessions.
- The subject was monitored during her summer break for 12 weeks from June to September,
 2009.
- The various anthropometric, cardiorespiratory, muscular strength and endurance, and flexibility tests, as well as the adolescent version of the Centers for Disease Control and Prevention's
 (CDC) Barriers to Being Active Quiz and 2009 Middle School Youth Risk Behavior Survey, used for each of the subject's assessments were both valid and reliable.

Limitations

This study was limited to the following:

- The subject did not have constant supervision for the duration of the study.
- Eating habits and level of physical activity were limited to self-report.
- Self-reported measures are subject to bias and can therefore be unreliable.
- Performance during training sessions and fitness assessments may have been affected by the subject's attitude towards physical activity and emotions.
- Her dietary habits may have been affected by her emotions and reluctance to try a variety of healthier food options.
- The level of motivation to adhere to the behavior change program was varied throughout the study.
- The food environment in the home did not adhere to recommendations by the researcher or change according to those suggestions.

Significance of the Study

While this study cannot be applied to the general population at large, the study design can provide a foundation for others who work with overweight and obese adolescents. It can offer a framework for training sessions, healthy and safe techniques to alter diet, and means to motivate an adolescent towards weight loss.

Definitions of Terms

- Resting Heart Rate (RHR)- Heart rate measured in beats per minute (bpm) after subject has been seated quietly for at least five minutes. This does not include pre-exercise heart rate. RHR can be affected by training, temperature extremes, and altitude (Wilmore, Costill, and Kenney, 2008).
- 2. Resting Blood Pressure (BP)- Blood pressure measured in mm Hg after subject has been seated for at least five minutes in a chair with back support and has refrained from smoking cigarettes or ingesting caffeine for 30 minutes prior to the test. Systolic and diastolic blood pressures are measured (American College of Sports Medicine, 2010).
- 3. <u>Body Mass Index (BMI)</u>- an anthropometric index calculated by dividing a person's weight in kilograms and dividing it by their height in meters². BMI= weight (kg) / height (m²). BMI is used to screen for weight categories that may be associated with comorbities. It is not a diagnostic tool (Centers for Disease Control and Prevention₂, 2009).
- 4. Centers for Disease Control and Prevention's (CDC) BMI-for-Age Growth Chart- a screening tool to assess underweight, risk of overweight, and overweight in children and adolescents. It consists of a series of percentile curves which depict the distribution of BMI in relation to age in U.S. children. This growth chart takes into account a child's sex, weight, stature, and age.
 - a. Underweight- < 5th percentile
 - b. Healthy weight-5th percentile to < 85th percentile

- c. Overweight- 85th percentile to < 95th percentile
- d. Obese- ≥ 95th percentile

(Centers for Disease Control and Prevention₂, 2009)

- 5. Resting Metabolic Rate (RMR)- represents the calories the body burns at rest to maintain vital body functions. It is used to appropriately establish a person's daily calorie needs and does not take into account physical activity (Microlife, 2010).
- Estimated VO₂ Max- an estimation of a person's maximal oxygen uptake capacity. VO₂ max is a
 measure of cardiorespiratory fitness. It is the product of cardiac output and arterial-venous
 oxygen difference (American College of Sports Medicine, 2010).
- 7. <u>Transtheoretical Model (TTM)</u>- a behavior change model. It specifies a time dimension in behavior change and proposes that people move through a series of stages during behavior change. The stages of change are:
 - a. Precontemplation- One is not considering change in the foreseeable future, defined as the next six months
 - Contemplation- One is considering change in the foreseeable future, but not immediately, defined as between one and six months
 - c. Preparation- One is planning for change in the immediate future, defined as in the next month
 - d. Action- One has made meaningful change in the past six months
 - e. Maintenance- One has maintained change for a period of time, defined as six or more months

(Sharma & Romas, 2008)

Chapter II-

Literature Review

Introduction

In a culture that encourages the consumption of excess energy and discourages energy expenditure, overweight and obesity are practically inevitable. This epidemic has not only affected adults, but children as well. In the last two decades, overweight and obesity prevalence has doubled in adults and tripled in children and teens (National Heart, Lung, and Blood Institute, 2010). Being overweight leads to multiple comorbidities, and it is crucial that prevention and intervention take place to slow and reverse these trends.

In this case study of a 14-year old obese female, vigorous exercise training sessions, specifically circuit training, were used in conjunction with dietary habit modification to achieve weight loss.

Education was a critical basis for the foundation of the study. Motivation, familial factors, and behavior change were all researched to examine their effects on a person's weight status. Childhood obesity is a multi-factorial problem facing our society, and there is no one way or easy way to fix it. Through research and investigation, more effective means of promoting weight loss and preventing overweight and obesity can be achieved.

Obesity

Obesity is a chronic condition in which a person carries excess body weight. For adults, body mass index (BMI), a height to weight ratio, is most commonly used to determine overweight and obesity. For children and adolescents, gender-specific BMI-for-age growth charts from the Centers for Disease Control and Prevention (CDC) are utilized. These take into account age and sex, as well as height and weight, because adiposity differs with age between boys and girls throughout this age group. A BMI percentile >5th and < 85th is considered normal weight for height, the 85th to the 95th percentile is

considered at risk for overweight, and $\geq 95^{th}$ percentile is defined as overweight (Centers for Disease Control and Prevention₂, 2009).

Prevalence of adolescent obesity has increased drastically in recent years. According to the 1976-1980 and 2003-2006 NHANES surveys, prevalence of obesity in adolescents aged 12–19 years has increased from 5.0% to 17.6% (National Heart, Lung, and Blood Institute, 2010). Because obesity is a multifactorial chronic condition, there are many avenues through which body weight is influenced. These factors include excess energy balance, poor dietary habits, physical inactivity, family environment, food environment inside and outside of the home, and self-esteem and motivation. Thus, all contribute to the increased prevalence of adolescent obesity.

Many morbidities are associated with overweight and obesity. Being overweight or obese increase a person's risk for medical conditions including cardiovascular disease (CVD), stroke, hypertension, type 2 diabetes, certain cancers, asthma, as well as psychological disorders (National Heart, Lung, and Blood Institute, 2010). Adolescents who are overweight are likely to be overweight or obese as adults and have the same risks for disease associated with their weight status. That is not to say, however, that these conditions do not occur or develop in adolescence. A CDC sample of 15-17 year-olds, results showed that 60% of overweight children had at least 1 CVD risk factor, and 25% had 2 or more CVD risk factors. Moreover, prevalence of type 2 diabetes, high blood lipids, and hypertension has increased with adolescent overweight and obesity rates (Centers for Disease Control and Prevention₁, 2009).

Overweight and obesity are taking many lives unnecessarily and for largely preventable reasons. Early interventions are clearly needed to reduce adolescent overweight and obesity, especially due to the comorbidities associated with increased weight status. Behavioral, physical activity, and dietary interventions are crucially important to reverse the trend toward overweight and obesity.

Physical Activity

Physical activity has been proven to prevent and treat lessen overweight and obesity by helping to maintain energy balance, as well as reduce the risk for the aforementioned medical conditions. The CDC recommends that adolescents should engage in at least 1 hour of physical activity every day, the majority of which should be comprised of either moderate or vigorous aerobic physical activity. Vigorous physical activity, strength training, and weight-bearing activities to stimulate bone strength should be performed at least three days per week (U.S. Department of Health and Human Services, 2009). Unfortunately, as age increases, level of physical activity tends to decrease.

Using data from the Youth Risk Behavior Surveillance System, Katzmarzyk, Baur, Blair, Lambert, Oppert, and Riddoch found that about 50% of U.S. boys ages 12 to 15 and 65% of girls in the same age range did not meet the recommended amounts of physical activity per day. They hypothesize that this low level of physical activity is contributed to decrease in active transportation, such as biking and walking, increased constraints on adolescents' time, increased time spent engaging in sedentary activities, and decreased discretionary and play time (400 minutes and 500 minutes per week, respectively) (Katzmerzyk et al., 2008).

Physical inactivity has been significantly linked to weight gain, overweight, and obesity. The solution to getting adolescents more active is not simply making them participate in physical activity on their own time or in PE classes. They need to learn to enjoy engaging in physical activity, build self-esteem and self-efficacy, and learn to be independent exercisers. In addition, they need to be educated on the health consequences not only of physical inactivity, but also of those pertaining to overweight and obesity that arises from a lack of physical activity. Ultimately, they need to be aware that being physically inactive will harm them and their health in the long-run.

Diet

Along with declining physical activity levels among youth, poor dietary habits also contribute to the childhood obesity epidemic. Zapata, Bryant, McDermott, and Hefelfinger developed the Youth Physical Activity and Nutrition Survey to assess dietary and physical activity knowledge and practices of middle school youth. Data from their survey was retrieved from 4,452 6th-8th graders in Florida at 73 middle schools. The 92-question survey consisted of items regarding demographics, "body weight, dietary behaviors, restaurant and school dining, school vending machine use, knowledge about nutrition and physical activity, participation in physical activity behaviors, after-school activities, television viewing, computer and video game use", as well as other items related to health behavior and status (Zapata et al., 2008). All responses were voluntarily and anonymously self-reported by the students.

Chi-square tests of independence were used to test for significance between demographic factors and selected survey items. Data were weighted by sex, grade, and region, and weighted frequency distributions were calculated to show the distribution of responses for each survey item.

Results indicated that 22.8% of surveyed students reported consuming 5 or more fruits and vegetables per day, most commonly drank whole, 2%, or chocolate milk, and 26% reported drinking 2 or more sodas per day in the last seven days. Fortunately, 46.6% reported eating breakfast every day in the previous 7 days. In regards to physical activity, 72.3% of respondents stated that they participated in at least 20 minutes of vigorous physical activity at least 3 out of the previous seven days, while only 7.3% reported not engaging in any moderate or vigorous physical activity in the last 7 days. Only 45.1% of the students attended PE classes on a daily basis, and, even more, 39.9% reported not attending PE classes at all during the average school week. Still, 39.4% reported that they spent most of their time after school playing outside, but this decreased with increases in grade level. Students also lacked knowledge about physical activity and nutrition. Only 17.8% correctly identified the recommendation of consuming 5 or more servings of fruits and vegetables per day, and 27% correctly identified the recommended

physical activity level for their age group. Further, 56.6% of surveyed students responded that physical activity prevented weight problems, 39.1% believed it prevented heart problems, and 34.8% stated that it improved mood, but what is more alarming is that 29% of the respondents did not know of any perceived benefits of physical activity (Zapata et al., 2008).

It is evident that middle school students in Florida need to participate in more healthful dietary and physical activity behaviors and works towards reaching optimal levels of both. Analysis of their current health-related behaviors does not create a positive outlook on the current pediatric obesity epidemic. Because the results of this study can be appropriately translated to the middle school population as a whole, early interventions for all adolescents will be critical to improving the health of our nation's youth.

Home Food Environment

Rosenkranz and Dzewaltowski explored a model of the home food environment related to childhood obesity. They studied macro- and micro-levels of the political and economic environments, sociocultural environments, and built and natural environments as to how factors of these environments relate to a child's nutritional intake. Factors included, but were not limited to, food pricing, family SES status, family food insecurity, race, ethnicity, and cultural identity, consumption trends, family structure, stress, and schedules, parenting practices, styles, and rules, parental eating/dieting, family eating patterns, education and nutrition knowledge, audiovisual media equipment, and kitchen appliances and cooking equipment. Together, these factors influence a child's weight status and should be addressed when creating an intervention program.

In the political and economic environments, the authors noted that childhood obesity increased by more than 200% in the Unites States from 1980 to 2000, while the relative price of food fell 14%, leading towards increased prevalence of obesogenic foods in the household. Further, children from lower SES families have parents that are more likely to use food as a reward, have less availability of and

eat less fruits and vegetables, are more likely to eat fast food, watch more television while eating, and are more likely to be overweight when compared to children of higher SES families. Food insecurity fosters feast and famine eating patterns, as well as consuming energy-rich foods when available, which both may lead to excess calorie intake among adolescents (Rosenkranz & Dzewaltowski, 2008).

In the sociocultural environments, race, ethnicity and cultural identity influence the home food environment in what foods are purchased and how food is prepared. According to the authors, "Children from ethnically diverse groups are at increased risk for obesity and are more likely to have diets failing to meet nutritional recommendations" (Rosenkranz & Dzewaltowski, 2008). Furthermore, one's culture influences one's ideals on body weight.

In addition, dietary consumption trends have become more obesogenic in the past few decades. Adolescents are consuming more soda, snacking more, and eating larger portions, all which can contribute to overweight and obesity among this population. Adolescents are also eating more food outside of their home. In the United States, approximately one-third of the food that teenagers consume is prepared outside of the home, and 20% of this food is from fast food restaurants (Rosenkranz & Dzewaltowski, 2008). Because eating meals at home as a family plays a significant role in healthy dietary intake among adolescents, these consumption trends could be detrimental to adolescents' weight statuses. Among other factors, limited food preparation skill may deter families from cooking healthful meals in the home, thus contributing to more frequent meals being consumed outside of the home and adolescents not learning healthful dietary choices or cooking skills.

In the realm of natural and built environments, audiovisual media equipment, which includes televisions, DVD players, and computers, is associated with fast-food consumption, lower fruit and vegetable consumption, increased consumption of fat and salty snacks, and obesity. The television, which is on approximately 25% of each day in American households, can promote an obesogenic home food environment through food advertising and promoting low energy expenditure and high energy

intake (Rosenkranz & Dzewaltowski, 2008). Computer use also fosters sedentary behavior among users. Also in the built environment, the kitchen plays a role in the home food environment in that the presence or absence of certain kitchen appliances and cooking equipment are indicative of a family's SES and health status. They also influence families' eating behaviors (Rosenkranz & Dzewaltowski, 2008).

The home food environment is composed of the political and economic, sociocultural, and built and natural environments and can play a significant role in an adolescent's behavior, consumption patterns, and food intake. Due to the epidemic levels obesity across the lifespan, it is crucial that families begin to be aware of modifiable factors the in the home food environment that are contributing to their child's weight status. Moreover, they need to take action to prevent overweight and obesity in their children.

Family

Golan and Crow wrote a paper reviewing how parents play a critical role in shaping the eating behaviors of their children. They examined modern obesogenic environmental factors, as well as what roles parents may play in modifying these factors in children's weight-related problems. While the current obesity epidemic can largely be contributed to the environment, they state that parents can be important players in slowing, and possibly reversing, obesity incidence and prevalence (Golan and Crow, 2004).

Golan and Crow focused on increased energy intake, reduction in physical activity, increase in sedentary behaviors, media messages such as food advertisements and images of idealized thin bodies, thinness culture, and dieting and how these factors have negatively affected today's children and their weight. They also specified how parents can play a role in the etiology and prevention of children's weight-related problems in ways such as parental knowledge, food selection, home eating patterns, and meal structure. Further, parenting food practice was found to influence a child's eating habits (Golan and Crow, 2004).

The authors suggested that rather than control what, when, and how much food their child consumes, parents should use a trust paradigm in which the child would decide when and how much to eat the healthful array of food that the parents would supply. This feeding style promotes healthy lifestyle and awareness of internal hunger and knowledge cues, all of which today's children are not sensitive to, thus influencing their weight-related problems (Golan and Crow, 2004).

Because parents provide their child's contextual environment, it is important for them to be aware of environmental and familial factors that influence their child's weight. Even more, parents need to realize that they can be central agents of change in their child's behavior and eating patterns, especially since parents are often looked up to as influential role models for their children.

Using data from the United States National Longitudinal Study of Adolescent Health, Crossman, Sullivan, and Benin examined the effect of the family environment on adolescents' weight status from grades 7 to 12. Their research on this topic included 10,828 participants who completed two in-home interviews that were six years apart, as well as filled out a health and related behavior questionnaire prior to the first interview. Researchers examined measures of family characteristics (family structure, parental obesity, socioeconomic status, and adolescent's demographics), family relationship (perception of parental control, parental control of diet and television time, minimum closeness between adolescent and parents, and perception that parents care), and adolescent weight and self-esteem (baseline weight measurement of adolescent, level of self-esteem, number of physical activities, hours of television watched and video games played per week, and breakfast consumption). The dependent variable was the adolescent's weight at the time of the second home interview.

Bivariate ordinal regression analyses and multivariate ordinal regression models were used to analyze the data. The findings showed that there is a high association between weight in adolescence and that in young adulthood. They stated, "When only adolescent weight is considered, being at risk for overweight increases the odds [of being overweight as a young adult] 832% and being overweight

increases them 2492%" (Crossman et al., 2006). Parental obesity, parental control of diet, adolescent's age, self-esteem, and aforementioned adolescent behaviors also increased a child's odds for being overweight, while higher parental socioeconomic status decreased it. Perceptions that the parents care about the child is associated with lower weights for females, but the opposite is true for male children. The effects of self-esteem on weight were only significant for females. Children whose parents allow them to skip breakfast, do not control diets, and do not limit their time spent on sedentary activities have a 32% and 168% risk for females and males, respectively, for being overweight or obese in adulthood (Crossman et al., 2006).

Clearly, children's weights are strongly influenced by obesogenic environmental factors. Home and family environments play an essential role in the development of a child's consumption habits, levels of physical activity, and risk for obesity. Thus, families, particularly the parents, provide an avenue through which obesity prevention can be attained.

Motivation

Stevenson and Lochbaum researched the revised social-cognitive model of achievement motivation. The purpose of this study was to examine this revised model in order to better understand a person's motivation to engage in leisure-time physical activity. Three hundred eighty six volunteers, who were recruited via personal communication through sources such as university classes and community churches and fitness centers, participated in this study.

Participants were given a series of questionnaires that measured autonomy for leisure-time fitness, implicit theories of ability, perceived competence, and achievement goals. These questionnaires were analyzed through MANOVAs, multiple regressions, and mediation and suppression. A replication study was conducted in order to see if the results were replicable. The results of this study supported the researchers' hypothesis that the mastery-approach goal, where one wants to exercise as well as one possibly can, largely affects the influence of incremental theory (learning and improvement) and

confidence on leisure-time exercise motivation. Thus, mastery goal plays an important role in working with unmotivated persons to both begin and adhere to an exercise program (Stevenson & Lochbaum, 2008).

Intervention Strategies for Adolescent Overweight and Obesity

Studies have shown that lifestyle behavior modification may produce the best long-term results for youth. Kris-Etherton, Champagne, and McManus reviewed weight loss strategies that included diet, physical activity, and behavior modification, concluding that all three are necessary for a successful and holistic weight loss intervention. They also noted that each of these three aspects must be individualized for the subject and that having options, especially in diet, is crucial for maximal program adherence and maintenance (Kris-Etherton, Champagne, & McManus, 2003).

Specifically, the authors reviewed low-fat, moderate-fat, and high-protein diets and their efficacy in weight loss. Low-fat diets were effective because the fat reduction in one's diet led to an overall decrease in caloric consumption. Secondly, they suggested that moderate-fat diets will produce the necessary calorie deficit needed for weight loss, yet the moderate amount of fat in the diet will produce bolder flavors in the food and more satiety in the dieter, possibly leading to long-term adherence. They did not recommend high-protein diets for weight loss because they lead dieters to believe that carbohydrates are detrimental to weight status, rather than fat. These diets were effective mainly due to caloric deficit, but were not concluded to be safe for the dieters due to the potential risks associated with a ketogenic diet. The authors believe that all three of these diets promote weight loss, and they suggest that further research be done on to investigate the diets' long-term effects and adherence (Kris-Etherton et al., 2003).

Kris-Etherton, Champagne, and McManus also reviewed physical activity and behavior modification as integral aspects of a weight loss program. They proposed that one should follow recommended guidelines for physical activity to promote weight loss. This includes engaging in

moderate to vigorous physical activity for at least one hour per day, as recommended by the CDC (U.S. Department of Health and Human Services, 2009). Further, the authors suggested behavior modification strategies for losing weight that included self-monitoring, stimulus control, cognitive restructuring, stress management, and social support (Kris-Etherton at al., 2003). Thus, effective behavior modification, in conjunction with physical activity and modified and improved dietary intake, are all necessary for a successful weight loss intervention.

Research conducted by Fulton, McGuire, Caspersen, and Dietz supported that of Kris-Etherton et al.. Fulton et al. studied weight loss and weight gain prevention intervention strategies for youth.

Through meta-analysis, they concluded that behavioral interventions for youth that are focused on diet and exercise are most effective, especially when components of the interventions include self-monitoring, goal-setting, reinforcement, prompting, and parental involvement. Even more, they believe interventions should include both weight loss and weight gain prevention strategies to optimize results (Fulton et al., 2001).

More specifically, the authors looked at type of exercise used in weight loss programs. They found that lifestyle exercise, which is defined as "unstructured physical activity or activity that is deliberately incorporated to increase the physical activity in an individual's daily regimen," was most effective in decreasing weight in youth, rather than a structured aerobic exercise program (Fulton et al., 2001). The type, intensity, and duration of exercise most effective for weight loss in youth is still to be determined. Still, it is important to recognize that exercise should be individualized and foster long-term, independent exercise adherence. Even more, while exercise is an integral component to a weight loss program for youth, one cannot overlook the diet and behavior modification as well, in order to produce the most effective intervention program (Fulton et al., 2001).

Summary

Overweight and obesity are multi-factorial conditions that cannot be treated or prevented with any one technical solution; it will take a multidisciplinary approach to decrease incidence and prevalence of these conditions. Clearly, physical activity and healthy dietary practices need to be increased among the adolescent population. In addition to that, however, other factors in one's environment must be addressed as well.

An adolescent's family can have a significant impact on a child's weight status. Children develop habits within their home and look to their parents as role models for behavior. Even more, parents have the obligation to create a healthy, non-toxic home food environment that fosters healthy weight status in their child. Children need to learn and value healthy behaviors, as well as build intrinsic motivation and self-efficacy in exercising, in order to lead a healthy lifestyle throughout their lives. Through a successful intervention, many factors in an adolescent's life will be addressed and modified in order to optimize the program's effects and build a healthier adolescent.

This case study approach will integrate physical activity, modified dietary practices, and lifestyle behavior alteration, as well as education and family involvement, in order to maximize the effects of the intervention. It will be tailored to the subject's individual needs and personal goals for optimal benefits, adherence, and maintenance. Through a holistic approach and the addressing of recognized influences on an adolescent's weight status, the subject will receive a comprehensive intervention aimed not only at weight loss, but also towards independent physical activity, self-efficacy, knowledge of physical activity and proper dietary habits, and living a healthy lifestyle overall.

Chapter III-

Methods and Procedures

This case study aimed to improve the subject's dietary practices by monitoring and altering her caloric intake where necessary and promote the adoption of healthy, lifelong physical activity through the development of new skills, knowledge, and behavior. To accomplish the goals of this intervention, the researcher and subject engaged in moderate to vigorous physical activity sessions 4-6 hours per week, and met with the subject and her family to discuss and teach nutritional strategies to foster healthy weight management. Activities included fitness assessments to gain baseline measurements and evaluate progress, cardiovascular and strength training, knowledge and behavioral assessments, and nutritional guidance.

Subject

The subject was a 14-year old female with a lifelong history of being overweight who self-selected herself into the study. At the time of pre-testing, she had a BMI of 30.4 kg/m² and was classified as obese according to the Centers for Disease Control's (CDC) Growth Charts. Her poor dietary habits began in childhood, and she had not yet learned to employ appropriate means to maintain a healthy weight status. She was actively involved in basketball and softball, yet her energy expenditure was not enough to foster healthy weight maintenance or weight loss. She believed that she needed to lose weight to become healthier, but did not take adequate actions or have the proper knowledge to do so.

This study was approved by the Cal Poly Human Subjects Committee.

Variables

Data was collected on the following measures:

- Height
- Weight

- Body mass index (BMI)
- Resting heart rate (HR)
- Resting blood pressure (BP)
- Waist circumference
- Basal metabolic rate (BMR)
- Body fat %
- Estimated VO₂ Max
- Muscular strength and endurance
- Flexibility
- Knowledge of and attitude towards physical activity and nutrition
- Current health behaviors
- Food intake
- Barriers to Physical Activity
- Level of physical activity
- Readiness to change according to the Transtheoretical Model (TTM)

Interventions

Cardiovascular fitness activities mainly included walking and running to improve endurance. In addition to this, the subject engaged in agility, speed, and power drills that were designed to not only increase her fitness but improve skills that could be transferred to her sports participation. Weekly, the subject engaged in increasingly longer distance runs at a moderate pace, and the researcher recorded the time of each of these runs. Other drills included the use of medicine balls, jump ropes, rope ladders to promote agility, speed, and power. In addition, she wore a pedometer daily to estimate energy expenditure, and she was expected to keep a physical activity log.

In attempts to increase the subject's strength, she engaged in strength training activities to engage all major muscle groups. In particular, the upper body and abdominal muscles were targeted, as they were the weakest at the beginning of the study and would be beneficial to strengthen both in terms of health and skill-building. Medicine balls, dumbbells, and bodyweight were used as the main forms of resistance during training. Timed interval circuit training was also employed to integrate strength, speed, power, and cardiovascular elements to improve fitness. Moreover, by improving the subject's overall strength, it was hoped that her basal metabolic rate (BMR) would increase as well, as she would be increasing lean muscle mass.

In an effort to improve the subject's dietary habits, she and her family were taught to use the American Dietetic Association's food exchange lists in order to make healthier and balanced food choices and lessen overall caloric intake, especially those from unhealthy, calorie-dense foods. The subject was not put on a specific diet regimen. Food options were provided to the family that were created by the researcher according to the subject's food preferences, so that they would have a list of healthy food alternatives and ideas to direct them towards healthier dietary habits and food choices. Additionally, the subject was asked to keep a weekly food journal, and her caloric intake was calculated based on a 3-day intake using ESHA Research's Food Processor SQL® software.

Questionnaires were given to the subject in order to assess her baseline knowledge of and attitude towards physical activity and nutrition, as well as her current health behaviors. These included the CDC's 2009 Middle School Youth Risk Behavior Survey, the CDC's adolescent version of the Barriers to Being Active Quiz, as well as questionnaires created by the researcher to determine the subject's relevant health knowledge and stage of change according to the TTM.

From June to September, 2009, the subject was on summer break from school and thus had a less structured schedule than during her school year. She was encouraged to continue to engage in regular physical activity with friends or on her own without the researcher. In addition, she was

expected to continue to be more conscious of her dietary intake and consume healthy foods and beverages throughout this time period. At the end of her summer break, a post-intervention assessment was conducted in order to see if the subject would show further improvements in any variables of the study.

Data Collection Procedures

Pre-, mid-, and post-intervention assessments were conducted at Cal Poly State University in the Human Performance Laboratory using PolyFit's equipment. PolyFit is the Cal Poly Kinesiology

Department's fitness assessment program. Assessments occurred at baseline, mid-program (eight weeks following baseline), and post-program (16 weeks following mid-program) to evaluate body composition, cardiovascular endurance, muscular strength and endurance, and flexibility. Height, weight, resting blood pressure (BP) and heart rate (HR), waist circumference, and body mass index (BMI) measurements were also taken at these times. BMR was estimated using the BodyGem® to determine the baseline amount of calories that the subject needed per day to sustain activities of daily living. Body composition, muscular strength and endurance, and flexibility were assessed by skin fold measurements, bioelectrical impedance analysis, hydrostatic weighing, hand-grip dynamometry, push-ups, curl-ups, and modified sit-and-reach testing, respectively. All of the above measurements were conducted utilizing the American College of Sports Medicine's Guidelines for Exercise Testing and Prescription. Cardiovascular endurance was estimated using Cal Poly's submaximal treadmill test. All testing protocols are explained below.

- Height in centimeters and weight in pounds were measured using PolyFit's stadiometer and weight scale, respectively.
- BMI was calculated in kg/m² after appropriate conversions had been made.
- Waist circumference was measured with the subject standing upright and relaxed. A horizontal
 measure was taken at the greatest anterior extension of the abdomen with a flexible, inelastic
 tape measure. Duplicate measures were taken to ensure accuracy.

- Resting heart rate was determined by radial pulse palpation.
- Resting blood pressure was measured using a blood pressure cuff and stethoscope. The subject sat quietly for at least five minutes in a chair with back support with her feet on the floor and her arm supported at heart level. She had refrained from ingesting caffeine for the 30 minutes preceding the measurement. The cuff was wrapped firmly around the upper arm at heart level and was aligned with the brachial artery. The appropriate cuff size was used so that he belly of the cuff encircled at least 80% of the upper arm. The stethoscope was placed over the antecubital space over the brachial artery, which was palpated by the researcher. The cuff was quickly inflated to 20 mm Hg above the first Korotkoff sound. Then, the pressure was slowly released at a rate equal to 2 to 5 mm Hg per second. Systolic and diastolic pressures were recorded, and at least two measurements were made a minimum of one minute apart.
- A three-site skinfold measurement was taken in the following locations: triceps (vertical fold; on the posterior midline of the upper arm, halfway between the acromion process and the olecranon processes, with the arm held freely to the side of the body), abdomen (vertical fold; 2 centimeters to the right of the umbilicus), and suprailiac (diagonal fold; in line with the natural angle of the iliac crest taken in the anterior axillary line immediately superior to the iliac crest). All measurements were taken on the right side of the body with the subject standing upright and within 1-2 seconds of placing the caliper halfway between the base and crest of the fold and perpendicular to the fold. Multiple measurements were taken, and the researcher rotated through measurement sites to allow skin to regain normal texture and thickness.
- The subject's body composition was assessed using a BIA analyzer, with the subject hydrated and relaxed in the supine position with her legs and arms abducted approximately 45° to each other on a nonconductive surface. Measurements were taken on the right side of the body.

 Electrode sites were cleaned with alcohol. Proximal electrodes were placed on (a) the dorsal

surface of the wrist so that the upper border of the electrode bisected the head of the ulna, and (b) the dorsal surface of the ankle so the upper surface of the electrode bisected the lateral and medial malleoli. Distal electrodes were placed on at the base of the second or third metacarpal-phalangeal joints of the hand and foot.

- The subject underwent hydrostatic weighing to determine body composition. Before the test begins, she was instructed to urinate and eliminate as much feces and gas as possible. Water temperature and water density was checked prior to the beginning of the test. The subject was completely submersed in water and exhaled as much air as she could. Residual volume was estimated, and underwater weight was recorded. Three to ten trials were administered. Results were calculated using PolyFit's body composition analyzing spreadsheet.
- Grip strength was assessed using a hand grip dynamometer that was properly adjusted to fit the
 subject's hand comfortably. She stood upright with her arms at her sides. The dynamometer
 was held parallel to the side with the dial facing away from the body. The client squeezed the
 dynamometer as hard as possible without moving the arm. Three trials were taken on each
 hand. The best scores on each hand were recorded.
- A push-up test was administered with the client in the modified "knee push up" position with the legs together, lower legs in contact with the mat and ankles plantar-flexed, back straight, hands shoulder width apart, head up, using the knees as the pivotal point. The subject raised the body by straightening the elbows and returned to the "down" position, until the chin touched the mat. The subject's back remained straight at all times, and she pushed up to a straight arm position. This test was conducted until failure or until proper technique could no longer be maintained within two repetitions. The maximal number of push-ups performed consecutively without rest was recorded as the score.

- A curl-up test was administered with the subject in a supine position on a mat with the knees at 90°. The arms were at her side, palms facing down with the middle fingers touching a piece of masking tape. A second piece of masking tape was placed 10 centimeters from the first. A metronome was set to 50 bpm, and the subject performed slow, controlled curl-ups to lift the shoulder blades off the mat (trunk will make 30° angle with the mat) in time with the metronome at a rate of 25 bpm. The low back was flattened before curling up again. The test was completed for one minute. The subject performed as many curl-ups as possible without pausing, to a maximum of 25.
- The Acuflex I®, a modified sit-and-reach box, was used to administer the sit and reach test. The subject properly warmed up prior to the first trial. Shoes were removed, and the client sat with her head, back, and hips against the wall. The indicator on the box was lined up with the client's fingertips to adjust for limb length. The subject gradually reached forward with both hands as far as possible and held the final position for approximately 2 seconds. Knees stayed flat against the floor during the test and hands were kept parallel, so that one hand did not lead. The score was the most distant point reached with the fingertips. The better of two trials was recorded.
- The Cal Poly Submaximal Treadmill test was utilized to estimate the subject's VO₂ max. This test followed the Bruce protocol. A proper warm up and cool down were administered. Workload was altered by changing speed and grade. Each stage of the test lasted 3-5 minutes to allow the subject to achieve a steady state heart rate. The subject reached two steady state heart rates between 115 and 150 bpm. Heart rate was monitored throughout the test using a Polar heart rate monitor, and Perceived Rating of Exertion was evaluated at each stage of the test. At the conclusion of the test, VO₂ max was predicted with the appropriate metabolic equation.
- The subject's basal metabolic rate was measured using the BodyGem®. She had not exercised vigorously, smoked, or consumed alcohol within 12 hours of the test, and she had fasted for at

least 6 hours. During the test, she sat quietly in an upright position, and the room lights were turned off. After a period of approximately 5 to 10 minutes, the BodyGem® produced the subject's estimated BMR.

- The subject was given a pedometer that calculates caloric expenditure and tracks physical
 activity level. This data was used as a guideline to balance the subject's energy expenditure with
 her caloric intake.
- The subject's mile time was recorded at regular intervals of one to two weeks.
- The subject kept a detailed food log for one week intervals. Data was used to assess the subject's dietary intake.
- Barriers to physical activity were determined by the adolescent version of the CDC's Barriers to
 Being Active Quiz at baseline and pos-program measurements.
- Physical activity, nutrition, and general health knowledge was assessed using a pre- and postprogram questionnaire.
- Healthy and unhealthy behaviors the subject engaged in were measured by the middle school version of the CDC's 2009 Middle School Youth Risk Behavior Survey at baseline and postprogram assessments.

Table 1, shown below, summarizes assessments and intervals at which the measurements were made:

Table 1: Data Collection Measurements and Intervals

Assessment Intervals					
			Mid-		
		Baseline	Program	Post-Intervention	
	Height (cm)	Х	X	X	
	Weight (kg)	Х	Х	Х	
	BMI (kg/m²)	Х	Х	X	
	Resting BP (mmHg)	X	Χ	X	
	Resting HR (bpm)	X	Х	Х	
	Waist Circ. (cm)	X	Х	Х	
	RMR (kcal/day)	X	Х	X	
cen	Skinfold (BF%)	X	Χ	Χ	
Taken	Hydrostatic Weighing (BF%)	X	Х	X	
nts	BIA (BF%)	X	Χ	Χ	
ner	Estimated VO₂ Max (mL/kg/min)	X	Х	X	
Measurements	Grip Strength (kg)	X	Χ	Χ	
eası	Push-Ups	X	Х	X	
ž	Curl-Ups	X	Χ	X	
	Modified Sit and Reach (in)	X	Χ	Χ	
	Stages of Change	X	Χ	Χ	
	PA and Nutrition Knowledge	X		Χ	
	Barriers to PA	X		Χ	
	Food Intake (kcal)	X	X	X	
	PA Level	X	Χ	Χ	
	Health Behaviors	X		X	

Data Analysis Procedure

The data collected from this study was reviewed using descriptive statistics. Data was characterized and examined in order to identify positive or negative changes within each variable. These results were compared to expected outcomes of the intervention.

Chapter IV-

Results

The following results report the data collected at baseline, mid-program, and post-program assessments. Baseline and mid-program assessments were 8 weeks apart, while post-program measurements were taken 16 weeks after the mid-program assessment. During the 16-week interval, the subject was on summer break without any intervention-related supervision from the researcher. The findings are summarized in Table 2 below.

Table 2: Results at Each Assessment Interval

		Assessment Intervals		
		Baseline	Mid-Program	Post-Intervention
	Height (cm)	172.6	172.7	173
	Weight (kg)	90.5	88.6	88.2
	BMI (kg/m²)	30.4	29.7	29.5
	Resting BP (mmHg)	118/80	112/74	124/78
	Resting HR (bpm)	70	62	68
	Waist Circ. (cm)	92.5	91	92.5
	RMR (kcal/day)	1720	1820	1750
Taken	Skinfold (BF%)	26.8	23.5	26.4
<u>a</u>	Hydrostatic Weighing (BF%)	27.4	24.9	25.1
nts	BIA (BF%)	40.6	40.3	40.8
mei	Estimated VO₂ Max (mL/kg/min)	42.4	44.6	36.1
Measurements	Grip Strength (kg)	R: 32 L: 31	R: 36 L: 34	R: 30 L: 27
eas	Push-Ups	22	50	39
Σ	Curl-Ups	23	36	25
	Modified Sit and Reach (in)	17	22	13.5
	Stages of Change	Contemplation	Action	Preparation
	PA and Nutrition Knowledge	_		\uparrow
	Barriers to PA	_		\downarrow
	Food Intake (kcal)	_	\downarrow	\uparrow
	PA Level	_		\downarrow
	Health Behaviors	<u> </u>		\uparrow

Height

Height increased at each assessment. From baseline to mid-program assessments, she grew 0.1 cm, and from mid- to post-program, she grew 0.3 cm. Total stature growth during the intervention was 0.4 cm.

Weight

Weight decreased by a total of 2.3 kg from baseline to post-program measurements. From baseline to mid-program measurements, her weight decreased by 1.9 kg, and from mid- to post-program, her weight decreased by 0.4 kg.

BMI

BMI decreased by 0.9 kg/m² during the intervention. It decreased by 0.7 from baseline to mid-program measurements and again decreased by 0.2 from mid- to post-measurements. At the time of the baseline assessment, she was classified as obese using the CDC's BMI-for-Age growth chart. When the mid- and post-program results were taken, she was classified as overweight using the same chart. Resting BP

Resting systolic blood pressure decreased by 2 mmHg and resting diastolic blood pressure decreased by 6 mmHg between baseline and mid-program assessments. Following mid-program measurements, resting systolic blood pressure increased by 12 mmHg and resting diastolic blood pressure increased by 4 mmHg. Post-intervention resting systolic blood pressure was higher than that taken at the baseline measurement.

Resting HR

Resting heart rate decreased by 2 bpm overall. From baseline to mid-program measurements, resting HR decreased by 8 bpm. From mid- to post-program, resting HR increased by 6 bpm.

Waist Circumference

Weight circumference had a net change of 0 cm. From baseline to mid-program assessments, waist circumference decreased by 1.5 cm, yet this same amount was regained between mid- and post-program measurements.

<u>RMR</u>

Resting metabolic rate increased by 100 kcal/day between baseline and mid-program assessments. However, RMR decreased by 70 kcal/day from mid- to post-program. Net increase in RMR was therefore 30 kcal/day.

Skinfold

Skinfold assessments revealed a decrease of 3.3% body fat between baseline and mid-program measurements. Body fat increased by 0.9% between mid- and post-program measurements. Total decrease in body fat was 2.4%.

Hydrostatic Weighing

Body fat percentage, as measured by hydrostatic weighing, decreased by 2.5% between baseline and mid-program assessments. It increased by 0.2% from mid-program to post-program measurements. Overall decrease in body fat percentage was 2.3%.

BIA

Through bioelectrical impedance analysis, it was revealed that body fat decreased by 0.3% from baseline to mid-program measurements and increased by 0.5% from mid- to post-program assessments. Net increase in body fat percentage was 0.2%.

Estimated VO₂ Max

Estimated VO_2 max increased by 2.2 mL/kg/min between baseline and mid-program measurements. However, it decreased by 8.5 mL/kg/min from mid- to post-program. Overall decrease in estimated VO_2 max was 6.3 mL/kg/min.

Grip Strength

Right hand grip strength increased by 4 kg from baseline to mid-program measurements and decreased by 6 kg between mid- and post-program measurements. Total decrease was 2 kg. Left hand grip strength increased by 3 kg from baseline to mid-program assessments and decreased by 7 kg from mid- to post- program assessments. Net decrease was 4 kg.

Push-Ups

The amount of push-ups the subject completed increased by 28 from baseline to mid-program assessments. From mid- to post-program assessments, the amount completed decreased by 11 push-ups. Overall increase in push-ups completed was 17.

Curl-Ups

The subject completed 13 more curl-ups at the mid-program assessment than she did at the baseline assessment. The number of curl-ups completed at the post-program assessment decreased by 11 from the mid-program assessment. Total increase in number of curl-ups completed was 2.

Modified Sit-and-Reach

The subject reached 5 more inches at the mid-program measurement than she did at the baseline measurement. However, her score decreased by 8.5 inches between the mid- and post program measurements. Overall decrease in her reach was 3.5 inches.

Stages of Change

At the time of the baseline assessment, it was determined that the subject was in the contemplation stage of the TTM. Mid-program, she was in the action stage, and by the time of post-program assessment, she had regressed to the preparation stage.

Physical Activity and Nutrition Knowledge

The subject completed a questionnaire evaluating her physical and activity knowledge. At the baseline assessment, she answered 60% of the questions correctly. When she retook the same evaluation, she answered all questions correctly.

Barriers to Physical Activity

The subject took the adolescent version of the CDC's Barriers to Being Active Quiz. Findings revealed that she formulated excuses not to exercise and could not adhere to an exercise program independently. After retaking this quiz, it was found that these same barriers were lessened, but not surmounted. No new barriers were marked by the subject.

Food Intake

The subject kept a food log that was evaluated using ESHA Research SQL® dietary analysis software for baseline, mid-, and post-program assessments. At the beginning of the intervention, the subject was, on average, consuming 2,200 kcal per day. Mid-program, she was ingesting an average of 1,900 kcal per day. At the time of post-testing, her daily diet consisted of approximately 2,000 kcal per day.

Physical Activity Level

At the time of the baseline assessment, the subject was engaging in moderate to vigorous physical activity for at least 30 minutes 1 day per week, on average. Mid-program, she was active 4-5 days per week, and post-program, she was active 2 days per week according to the aforementioned criteria.

Health Behaviors

The subject completed the CDC's 2009 Middle School Youth Risk Behavior Survey at the time of baseline and post-program assessments. When she first completed the survey, it was revealed that she had engaged in unhealthy behaviors relating to safety, alcohol and tobacco usage, body weight, and

physical activity. She reported that she rarely wears a helmet riding a bike and never wears a seat belt when riding in a car. She has tried both cigarettes and alcohol, but is not a regular user. She believed she was very overweight and has exercised, eaten less food, fewer calories, or foods low in fat, and gone without eating for 24 hours or more in order to lose weight. She engaged in physical activity for at least 60 minutes once a week, watched TV 2 hours per day, and used the computer 3 hours per day.

When the subject completed the same questionnaire post-program, her responses to items regarding body weight and physical activity changed. She had not fasted for 24 hours or more in order to lose weight. Her physical activity increased to 2 days per week, and physical inactivity due to TV and computer usage decreased by 1 hour per week. All other responses remained unchanged.

Chapter V-

Discussion

The purpose of this case study was to assess an adolescent female's weight status and nutritional habits before, during, and after an intervention designed to increase physical activity and modify dietary practices. For the first eight weeks of the intervention, the researcher worked with the subject, giving her dietary strategies and leading her through workouts at least 2 days per week. The mid-program measurements occurred at the end of this eight-week period. Following this, the subject began her summer break and had no direct contact with the researcher. Post-program testing occurred at the end of the subject's summer vacation, which was sixteen weeks after the mid-program assessment. It was expected through this study that the subject would decrease weight-related measures and increase physiological factors related to physical activity and healthy dietary practices. Further, she would overcome psychological barriers to exercise and improve her attitudes towards physical activity.

Height, weight, waist circumference, and BMI did not alter over the 24-week period. However, the subject's body composition changed between each of the measurement intervals. From baseline to mid-program, she gained strength through increased muscle mass, as seen in the muscular strength and endurance and body composition assessments. Her adiposity decreased from baseline to mid-program assessments, while the opposite occurred from mid- to post-program assessments. RMR increased between baseline and mid-program assessments, and then returned to baseline at the post-program measurement. Estimated VO₂ max increased from baseline to mid-program, then decreased beyond the baseline measurement and the post-program assessment. Flexibility followed the same trend as VO₂ max. Psychological variables and lifestyle behaviors fluctuated positively and negatively throughout the 24 weeks.

Physiological Variables

From baseline through post-program assessments, height, weight, waist circumference, and BMI did not change, yet the subject gained muscle weight and lost fat mass. This could have resulted from the subject's increased physical activity and modified food intake during the first eight weeks of the intervention, followed by a decrease in physical activity and an increase in poor dietary choices over her summer break. De-conditioning and poor dietary intake led to a gain in fat mass, and a loss of fat free mass. These behaviors ultimately led to no overall change in aforementioned variables.

Muscular strength and endurance increased through the subject's training program, which included resistance and cardiovascular exercises. She endured muscular hypertrophy, as well as greater capillary and mitochondrial density, and greater neuromuscular recruitment, which led to increased strength and muscular endurance. Along with this, RMR increased with muscle mass because more energy is needed to contract the muscles. De-conditioning and muscular atrophy occurred between the mid- and post-program assessments due to decreased physical activity levels.

Estimated VO_2 max increased as the subject participated in her exercise regimen. Cardiovascular training led to a greater estimated VO_2 max because of increased capillary density, glucose and triglyceride storage, and increased lactase threshold, all of which lead to greater cardiovascular endurance. Similar to muscular strength and endurance, de-conditioning following the mid-program assessment led to decreased estimated VO_2 max below the baseline assessment result.

Flexibility increased as the subject participated in her physical activity program, which included stretching exercises at the end of each session. Regular stretching and exercise facilitated greater flexibility. Flexibility decreased from mid- to post-program assessments because of the subject's decrease in physical activity and stretching, which led to increased muscle stiffness.

Psychological Variables

The subject went through the contemplation, action, and preparation stages of the

Transtheoretical Model for behavior change at the baseline, mid-program, and post-program intervals,
respectively. She made progress in adopting healthy lifestyle behaviors for the first eight weeks of the
program, yet she regressed to old habits between the mid- and post-program assessments when she
had no structured schedule. Motivation and self-efficacy grew during the first eight weeks due, in part,
to increased physical activity and nutritional knowledge. With greater motivation and self-efficacy, along
with companionship support from the researcher, the subject's perceived barriers to physical activity
decreased. After the mid-program assessment, her motivation to adhere to behavior change decreased.
Because motivation and self-efficacy have a direct relationship, her self-efficacy decreased with her
motivation, and she began to create excuses that did not foster healthy lifestyle behaviors.

Lifestyle Behaviors

The subject was not able to maintain an exercise program or continue to eat a healthy diet when the researcher was not present. In turn, the subject began to engage in additional unhealthy lifestyle behaviors after the mid-program assessment. Without positive companionship support from the researcher, the subject relapsed into her previous, comfortable habits. However, there were positive outcomes to the study despite decreased health behaviors at the end of the program. The subject controlled her weight by healthy means and increased her physical activity from baseline measurements.

Familial Support

Familial support was not optimal during the entire program. The home food environment did not foster healthy dietary choices, and the parents did not set examples of how to maintain healthy weights or lifestyles. Without support from her family, the subject faced hurdles beyond her control that

interfered with her progress and adoption of healthy behaviors. It is believed that this lack of familial support played a large role in the magnitude of the effect of this intervention.

Conclusions and Recommendations

This intervention improved the subject's health measures for the first eight weeks of the program. When the subject was on her own during her summer break, she did not independently engage in healthful behaviors. Lack of familial support hindered the subject's ability to adopt long-term behavior change. Also, it is important to address this type of behavior change in several spheres, not only on the individual level. The whole person and their environment need to be targeted in order to foster optimal wellness in an individual.

Similar studies in the future should directly address the subject's home environment and familial support system at the beginning of the project. These are critical components to the subject's success, as supportive environments will foster greater achievement. Even more, involving and educating family members will likely lead to greater program adherence and effectiveness for the subject. If the program will run during the subject's summer break, supervision from the researcher is advised in order to help the subject maintain healthy nutritional and physical activity patterns during that time. Further, appropriate and planned incentives should be given to the subject when the subject meets designated goals in the program. Lastly, spheres excluding the subject's home environment should be incorporated into the intervention program. It would be beneficial to include intrapersonal levels and target factors in the subject's school, community, and social network.

Works Cited

- American College of Sports Medicine. (2010). *ACSM's guidelines for exercise testing and prescription* (8th ed.). Philadelphia, PA: Lippincott, Williams, and Wilkins.
- Centers for Disease Control and Prevention₁. (2009). *Tips for parents Ideas to help children maintain a healthy weight*. Retrieved April 12, 2010 from http://www.cdc.gov/healthyweight/children/index.html.
- Centers for Disease Control and Prevention₂. (2009). *Using the BMI-for-age growth charts*. Retrieved

 May 1, 2010 from

 http://www.cdc.gov/nccdphp/dnpa/growthcharts/training/modules/module1/text/module1pri

 nt.pdf
- Crossman, A., Sullivan, D. A., & Benin, M. (2006). The family environment and American adolescents' risk of obesity as young adults. *Journal of Social Science and Medicine*, *63:2255-2267*. doi: 10.1016/j.socscimed.2006.05.027
- Fulton, J. E., McGuire, M. T., Caspersen, C.J., & Dietz, W. H. (2001). Interventions for weight loss and weight gain prevention among youth. *Sports Medicine*, *31*(3):153-165.
- Golan, M. & Crow, S. (2004). Parents are key players in the prevention and treatment of weight-related problems. *Nutrition Reviews*, *62(1):39-50*. doi: 10.1301/nr.2004.jan.39-50
- Katzmarzyk, P. T., Baur, L. A., Blair, S. N., Lambert, E. V., Oppert, J., & Riddoch, C. (2008). International conference on physical activity and obesity in children: Summary statement and recommendations. *Applied Physiology, Nutrition, and Metabolism, 33:371-388.* doi: 10.1139/H07-176
- Kris-Etherton, P., Champagne, C., & McNamus, K. (2003). Attaining successful weight loss with an ideal macronutrient balance. *Holistic Nursing Practice*, *17*(*5*):250-261.

- Microlife. (2010). *BodyGem*. Retrieved April 30, 2010 from http://www.mimhs.com/watchwt/solutions/bodygem/bga/.
- National Heart, Lung, and Blood Institute. (2010). *Diseases and conditions index: What are overweight*and obesity? Retrieved April 10, 2010 from

 http://www.nhlbi.nih.gov/health/dci/Diseases/obe/obe_whatare.html
- Odgen, C. L., Carroll, M. D., Curtin, L. R., Lamb, M. M., & Flegal, K. M. (2010). Prevalence of high body mass index in US children and adolescents, 2007-2008. *Journal of the American Medical Association*, 303 (3):242-249. doi: 10.1001/jama.2009.2012
- Rosenkranz, R. R., & Dzewaltowski, D.A. (2008). Model of the home food environment pertaining to childhood obesity. *Nutrition Reviews*, 66(3):123-140.
- Sharma, M., & Romas, J. A. (2008). *Theoretical foundations of health education and health promotion*.

 Sudbury, MA: Jones and Bartlett Publishers.
- Stevenson, S. J., & Lochbaum, M. R. (2008). Understanding exercise motivation: Examining the revised social-cognitive model of achievement motivation. *Journal of Sport Behavior*, 31(4):389-412.
- U.S. Department of Health and Human Services. (2009). 2008 physical activity guidelines for Americans:

 Fact sheet for health professionals on physical activity guidelines for children and adolescents.

 Retrieved April 8, 2010 from

 http://www.cdc.gov/nccdphp/dnpa/physical/pdf/PA Fact Sheet Children.pdf
- Wilmore, J., Costill, D., & Kenney, W. L. (2008). *Physiology of sport and exercise* (4th ed.). Champaign, IL: Human Kinetics.
- Zapata, L. B., Bryant, C. A., McDermott, R. J., & Hefelfinger, J.A. (2008). Dietary and physical activity behaviors of middle school youth: The Youth Physical Activity and Nutrition Survey. *Journal of School Health, 78(1):9-18*.

Appendix

- 1. CDC 2009 Middle School Youth Risk Behavior Survey
- 2. Adolescent Version of the CDC Barriers to Being Active Quiz
- 3. Physical Activity and Nutrition Knowledge Questionnaire
- 4. Stages of Change Questionnaire

2009 Middle School Youth Risk Behavior Survey

This survey is about health behavior. It has been developed so you can tell us what you do that may affect your health. The information you give will be used to develop better health education for young people like yourself.

DO NOT write your name on this survey. The answers you give will be kept private. No one will know what you write. Answer the questions based on what you really do.

Completing the survey is voluntary. Whether or not you answer the questions will not affect your grade in this class. If you are not comfortable answering a question, just leave it blank.

The questions that ask about your background will be used only to describe the types of students completing this survey. The information will not be used to find out your name. No names will ever be reported.

Make sure to read every question. Fill in the ovals completely. When you are finished, follow the instructions of the person giving you the survey.

Thank you very much for your help.

DIRECTIONS

Use a #2 pencil only.

Make dark marks.

Fill in a response like this: A B D

If you change your answer, erase your old answer completely.

- 1. How old are you?
- A. 10 years old or younger
- B. 11 years old
- C. 12 years old
- D. 13 years old
- E. 14 years old
- F. 15 years old
- G. 16 years old or older
- 2. What is your sex?
- A. Female
- B. Male
- 3. In what grade are you?
- A. 6th grade
- B. 7th grade
- C. 8th grade
- D. Ungraded or other grade
- 4. Are you Hispanic or Latino?
- A. Yes
- B. No
- 5. What is your race? (Select one or more responses.)
- A. American Indian or Alaska Native
- B. Asian
- C. Black or African American
- D. Native Hawaiian or Other Pacific Islander
- E. White

The next 4 questions ask about safety.

6.	When y	ou ride a	bicycle,	how often	do you	wear a helmet?
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- A. I do not ride a bicycle
- B. Never wear a helmet
- C. Rarely wear a helmet
- D. Sometimes wear a helmet
- E. Most of the time wear a helmet
- F. Always wear a helmet

7. When you rollerblade or ride a skateboard, how often do you wear a helmet?

- A. I do not rollerblade or ride a skateboard
- B. Never wear a helmet
- C. Rarely wear a helmet
- D. Sometimes wear a helmet
- E. Most of the time wear a helmet
- F. Always wear a helmet
- 8. How often do you wear a seat belt when riding in a car?
- A. Never
- B. Rarely
- C. Sometimes
- D. Most of the time
- E. Always
- 9. Have you ever ridden in a car driven by someone who had been drinking alcohol?
- A. Yes
- B. No
- C. Not sure

The next 3 questions ask about violence-related behaviors.

- 10. Have you ever carried a weapon, such as a gun, knife, or club?
- A. Yes
- B. No
- 11. Have you ever been in a physical fight?
- A. Yes
- B. No

12. Have you ever been in a physical fight in which you were hurt and had to be treated by a doctor or nurse?
A. Yes B. No
The next question asks about bullying. Bullying is when 1 or more students tease, threaten, spread rumors about, hit, shove, or hurt another student over and over again. It is not bullying when 2 students of about the same strength or power argue or fight or tease each other in a friendly way.
13. Have you ever been bullied on school property?
A. Yes B. No
The next 3 questions ask about attempted suicide. Sometimes people feel so depressed about the future that they may consider attempting suicide or killing themselves.
14. Have you ever seriously thought about killing yourself?
A. Yes B. No
15. Have you ever made a plan about how you would kill yourself?
A. Yes B. No
16. Have you ever tried to kill yourself?
A. Yes B. No
The next 8 questions ask about tobacco use.
17. Have you ever tried cigarette smoking, even one or two puffs?
A. Yes B. No

- 18. How old were you when you smoked a whole cigarette for the first time?
- A. I have never smoked a whole cigarette
- B. 8 years old or younger
- C. 9 years old
- D. 10 years old
- E. 11 years old
- F. 12 years old
- G. 13 years old or older
- 19. During the past 30 days, on how many days did you smoke cigarettes?
- A. 0 days
- B. 1 or 2 days
- C. 3 to 5 days
- D. 6 to 9 days
- E. 10 to 19 days
- F. 20 to 29 days
- G. All 30 days
- 20. During the past 30 days, on the days you smoked, how many cigarettes did you smoke per day?
- A. I did not smoke cigarettes during the past 30 days
- B. Less than 1 cigarette per day
- C. 1 cigarette per day
- D. 2 to 5 cigarettes per day
- E. 6 to 10 cigarettes per day
- F. 11 to 20 cigarettes per day
- G. More than 20 cigarettes per day
- 21. During the past 30 days, how did you usually get your own cigarettes? (Select only one response.)
- A. I did not smoke cigarettes during the past 30 days
- B. I bought them in a store such as a convenience store, supermarket, discount store, or gas station
- C. I bought them from a vending machine
- D. I gave someone else money to buy them for me
- E. I borrowed (or bummed) them from someone else
- F. A person 18 years old or older gave them to me
- G. I took them from a store or family member
- H. I got them some other way
- 22. Have you ever smoked cigarettes daily, that is, at least one cigarette every day for 30 days?
- A. Yes
- B. No

PROMOTING HEALTH WEIGHT IN AN ADOLESCENT LEWALE
23. During the past 30 days, on how many days did you use chewing tobacco , snuff , or dip , such as Redman, Levi Garrett, Beechnut, Skoal, Skoal Bandits, or Copenhagen?
A. 0 days B. 1 or 2 days C. 3 to 5 days D. 6 to 9 days E. 10 to 19 days F. 20 to 29 days G. All 30 days
24. During the past 30 days, on how many days did you smoke cigars, cigarillos, or little cigars?
A. 0 days B. 1 or 2 days C. 3 to 5 days D. 6 to 9 days E. 10 to 19 days

The next 2 questions ask about drinking alcohol. This includes drinking beer, wine, wine coolers, and liquor such as rum, gin, vodka, or whiskey. For these questions, drinking alcohol does not include drinking a few sips of wine for religious purposes.

- 25. Have you ever had a drink of alcohol, other than a few sips?
- A. Yes

F. 20 to 29 days G. All 30 days

- B. No
- 26. How old were you when you had your first drink of alcohol other than a few sips?
- A. I have never had a drink of alcohol other than a few sips
- B. 8 years old or younger
- C. 9 years old
- D. 10 years old
- E. 11 years old
- F. 12 years old
- G. 13 years old or older

The next 2 questions ask about marijuana use. Marijuana also is called grass or pot.

- 27. Have you ever used marijuana?
- A. Yes
- B. No

28. How old were you when you tried marijuana for the first time?
A. I have never tried marijuana B. 8 years old or younger C. 9 years old D. 10 years old E. 11 years old F. 12 years old G. 13 years old or older
The next 3 questions ask about other drugs.
29. Have you ever used any form of cocaine, including powder, crack, or freebase?
A. Yes B. No
30. Have you ever sniffed glue, or breathed the contents of spray cans, or inhaled any paints or sprays to get high?
A. Yes B. No
31. Have you ever used steroid pills or shots without a doctor's prescription?
A. Yes B. No
The next 4 questions ask about sexual intercourse.
32. Have you ever had sexual intercourse?
A. Yes B. No
33. How old were you when you had sexual intercourse for the first time?
A. I have never had sexual intercourse B. 8 years old or younger C. 9 years old D. 10 years old E. 11 years old F. 12 years old G. 13 years old or older

A. Yes B. No

34. With how many people have you ever had sexual intercourse?
A. I have never had sexual intercourse B. 1 person C. 2 people D. 3 people E. 4 people F. 5 people G. 6 or more people
35. The last time you had sexual intercourse, did you or your partner use a condom?
A. I have never had sexual intercourse B. Yes C. No
The next 7 questions ask about body weight.
36. How do you describe your weight?
A. Very underweight B. Slightly underweight C. About the right weight D. Slightly overweight E. Very overweight
37. Which of the following are you trying to do about your weight?
 A. Lose weight B. Gain weight C. Stay the same weight D. I am not trying to do anything about my weight
38. Have you ever exercised to lose weight or to keep from gaining weight?
A. Yes B. No
39. Have you ever eaten less food, fewer calories, or foods low in fat to lose weight or to keep from gaining weight?

40. Have you ever gone without eating for 24 hours or more (also called fasting) to lose weight or to keep from gaining weight?
A. Yes B. No
41. Have you ever taken any diet pills, powders, or liquids without a doctor's advice to lose weight or to keep from gaining weight? (Do not include meal replacement products such as Slim Fast.)
A. Yes B. No
42. Have you ever vomited or taken laxatives to lose weight or to keep from gaining weight?
A. Yes B. No
The next 5 questions ask about physical activity.
43. During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day ? (Add up all the time you spent in any kind of physical activity that increased your heart rate and made you breathe hard some of the time.)
A. 0 days B. 1 day C. 2 days D. 3 days E. 4 days F. 5 days G. 6 days H. 7 days
44. On an average school day, how many hours do you watch TV?
A. I do not watch TV on an average school day B. Less than 1 hour per day C. 1 hour per day D. 2 hours per day E. 3 hours per day F. 4 hours per day G. 5 or more hours per day

45. On an average school day, how many hours do you play video or computer games or use a computer for something that is not school work? (Include activities such as Nintendo, Game Boy, Play Station, Xbox, computer games, and the Internet.)

Xbox, computer games, and the Internet.)
A. I do not play video or computer games or use a computer for something that is not school work B. Less than 1 hour per day C. 1 hour per day D. 2 hours per day E. 3 hours per day F. 4 hours per day G. 5 or more hours per day
46. In an average week when you are in school, on how many days do you go to physical education (PE) classes?
A. 0 days B. 1 day C. 2 days D. 3 days E. 4 days F. 5 days
47. During the past 12 months, on how many sports teams did you play? (Include any teams run by your school or community groups.)
A. 0 teams B. 1 team C. 2 teams D. 3 or more teams
The next 3 questions ask about other health-related topics.
48. Have you ever been taught about AIDS or HIV infection in school?
A. Yes B. No C. Not sure
49. Has a doctor or nurse ever told you that you have asthma?
A. Yes B. No C. Not sure

- 50. Do you still have asthma?
- A. I have never had asthma
- B. Yes
- C. No
- D. Not sure

This is the end of the survey.

Thank you very much for your help.

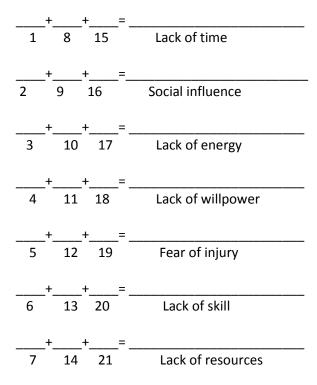
Barriers to Being Active Quiz (Adolescent Version) What keeps you from being more active?

Directions: Listed below are reasons that people give to describe why they do not get as much physical activity as they think they should. Please read each statement and indicate how likely you are to say each of the following statements:

How likely are you to say?	Very	Somewhat	Somewhat	Very
	likely	likely	unlikely	unlikely
1. My day is so busy now, I just don't think I can make	3	2	1	0
the time to include physical activity in my regular				
schedule.				
2. None of my family members or friends like to do	3	2	1	0
anything active, so I don't have a chance to be				
physically active.				
3. I'm just too tired after school/work to be active.	3	2	1	0
4. I've been thinking about becoming more physically	3	2	1	0
active, but I just can't seem to get started.				
Participating in physical activities can be risky.	3	2	1	0
6. I don't get enough exercise because I have never	3	2	1	0
learned the skills for any one sport.				
7. I don't have access to jogging trails, swimming pools,	3	2	1	0
bike paths, etc.				
8. Physical activity takes too much time away from other	3	2	1	0
commitments—like work, family, etc.				
9. I'm embarrassed about how I will look when I	3	2	1	0
participate in physical activity with others.				
10. I don't get enough sleep as it is. I just couldn't get up	3	2	1	0
early or stay up late to be physically active.				
11. It's easier for me to find excuses not to be physically	3	2	1	0
active than to go out and do something.				
12. I know of too many people who have hurt themselves	3	2	1	0
by overdoing when they are physically active.				
13. I really can't see learning a new sport.	3	2	1	0
14. It's just too expensive. You have to take a class or	3	2	1	0
join a club or buy the right equipment.				
15. My free times during the day are too short to include	3	2	1	0
physical activity.				
16. My usual social activities with family or friends do not	3	2	1	0
include physical activity.				
17. I'm too tired during the week and I need the	3	2	1	0
weekend to catch up on my rest.				
18. I want to be more physically active, but I just can't	3	2	1	0
seem to make myself stick to anything.				
19. I'm afraid I might injure myself.	3	2	1	0
20. I'm not good enough at any physical activity to make	3	2	1	0
it fun.				
21. If we had exercise facilities and showers at	3	2	1	0
work/school, then I would be more likely to be				
physically active.				

Follow these instructions to score yourself:

- Enter the circled number in the spaces provided, putting together the number for statement 1 on line 1, statement 2 on line 2, and so on.
- Add the three scores on each line. Your barriers to physical activity fall into one or more
 of seven categories: lack
 of time, social influences, lack of energy, lack of willpower, fear of injury, lack of skill,
 and lack of resources. A score
 of 5 or above in any category shows that this is an important barrier for you to
 overcome.



This Barriers to Being Active Quiz is used by permission from the SyberShop CD, North Carolina State University Cooperative Extension and A&T State University. Questionnaire is adapted from the "Barriers to Being Active" quiz in: US Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Division of Nutrition and Physical Activity. *Promoting Physical Activity: A Guide for Community Action*. Champaign, IL: Human Kinetics, 1999 (available online at http://www.cdc.gov/nccdphp/dnpa/physical/life/barriers_quiz.pdf). For more information on the SyberShop CD, contact: North Carolina Cooperative Extension Service at 919.515.9142.

Physical Activity and Nutrition Knowledge Questionnaire

1. How many fruits and vegetables should you eat each day?											
0	1	2	3	4	5	6					
2. Which are example of healthy foods?											
a) tof	a) tofu										
b) co	b) couscous										
c) qu	c) quinoa										
d) cu	d) cucumber										
e) all	of the al	bove									
3. How	big is a s	serving s	size of m	eat?							
a) a b	aseball										
b) yo	ur fist										
c) the	e whole p	olate									
d) a c	leck of c	ards									
4. How	many m				ise each	day?					
0	5-10	10-20	20-25	35-45	60+						
						_					
5. How	many da			-							
0	1	2	3	4	5	6	7				
C 14/1:											
	ch is an e		or aeror	oic exerc	ise?						
	ing weig	nts									
•	etching										
	ying tag										
d) pla	ying cat	ch									

- 7. Which is an example of flexibility?
 - a) touching your toes
 - b) arm circles
 - c) stretching after a sporting event
 - d) all of the above
- 8. Which is an example of muscular strength?
 - a) sit ups
 - b) running a mile
 - c) jumping rope
 - d) playing cards
- 9. Fitness includes:
 - a) cardiovascular and muscular strength and endurance
 - b) cardiovascular, muscular strength and endurance, flexibility and body composition
 - c) body composition, muscular strength and endurance
 - d) flexibility and body composition

Stages of Change Questionnaire

1. How	many h	ours do	you wat	ch TV ea	ich day?							
0	0-1	1-2	2-3	3-4	5+							
2. How	many h	ours of	TV do yo	u watch	per wee	ek?						
0	1-5	5-10	10-15	15-20	20-25	25-30	30+					
3. How	many h	ours do	you spe	nd playi	ng video	or com	outer ga	mes an	d using t	he inter	net each	day?
0	0-1	1-2	2-3	3-4	5+							
4. How	many h	ours do	you spe	nd playi	ng video	or com	outer ga	mes an	d using t	he inter	net each	week?
0	1-5	5-10	10-15	15-20	20-25	25-30	30+					
5. How	many h	ours do	you spe	nd doing	g homew	ork eac	h day?					
0	30 min	utes	1 hour		1.5 hou	ırs	2+ hou	rs				
6. Do y	ou think	that yo	u spend	too mud	ch time v	watching	g TV, on	the com	nputer, a	and play	ing video	games
each w	eek?	Yes	No									
Why?_												
7. Do y	ou play	on any s	ports te	ams?	Yes	No						
•		•	•									
How m	any hou	ırs of pra	actice an	d games	each w	eek? 1-	-2	3-4	5-6	7-8	9-10	10+
If no, w	hy not?	•										
 Would	you like	to parti	cipate ir	sports?		Yes	No					
8. How	many d	lays in ea	ach weel	k do you	engage	in physi	cal activ	ity with	your fa	mily?		
0	1	2	3	4	5	6	7					

9. What kinds of outdoor activities do you do with your family (i.e. hiking, yard work)?										
	-	-			-	tive with	your family?	Yes	No	
11. H	ow ma	ny fruits	do you e	eat each	day?					
0	1	2	3	4	5	6+				
12. H	ow ma	ny veget	ables do	you eat	each da	y?				
0	1	2	3	4	5	6+				
13. H	ow ma	ny times	does yo	ur famil	y eat din	ner at ho	ome each weel	< ?		
0	1	2	3	4	5	6	7			
14. H	ow ma	ny meals	does yo	our famil	y eat ou	t each w	eek?			
0	1	2	3	4	5	6	7+			
15. H	ow ma	ny times	each we	eek do y	ou buy lı	unch at s	chool?			
0	1	2	3	4	5					
	-	hink you k this? D		-		No hier?				
	-	hink you				No				

18. Do you think being more active and eating healthier foods would make you feel better? Yes No