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A Review of the Relationship between Screen Time and Low Levels of Physical Activity with Obesity and Sedentary Behaviors in Children and Adolescents

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By

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ABSTRACT

INTRODUCTION: The prevalence of childhood obesity currently lies at 17% in the United States alone and continues to increase each year. Obesity generally is a result of an imbalance between energy intake and energy expenditure. The increase of childhood obesity prevalence may have adverse morbidity and mortality implications in adulthood, including increased risk of developing Type 2 diabetes, heart disease, certain cancers, insulin resistance, and more. Multiple factors contribute to childhood obesity, including parental behaviors, socioeconomic factors, and media influence. Studies have shown that sedentary behaviors, such as watching television and playing video games, are a major contributor to obesity in children and adolescents. National guidelines recommend that children engage in a minimum of an hour of moderate physical activity every day, yet studies show they are not meeting these requirements.

AIM: The aim of this Capstone project is to examine the relationship between screen time and low levels of physical activity with obesity and sedentary behaviors in children and adolescents. The aim is also to examine ways to leverage screen time as a strategy to increase physical activity levels, particularly through the use of active video games.

METHODS: A review of relevant literature

RESULTS: The findings of this Capstone project support the idea that high levels of sedentary activity and screen time are associated with weight gain and obesity in children and adolescents. Evidence was present that active video games can serve as a promising strategy to increasing physical activity levels among children and adolescents. Reducing sedentary behaviors must happen at the home, institution, and community level.

DISCUSSION: The battle of childhood obesity has shown progress in recent years. Studies show that states are now showing progress in decreasing childhood obesity rates, particularly among low-income preschoolers aged 2 to 4 years. Evidence from the literature review shows that sedentary behaviors in adolescents are associated with negative health outcomes. The literature revealed that excessive television is linked to weight gain. Evidence suggests that targeting parents' behavior is essential to reducing sedentary behaviors among adolescents. The literature review revealed that the use of active video games serves as a promising approach to reducing sedentary behaviors and increasing physical activity levels in children and adolescents.

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by

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APPROVAL PAGE

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DEDICATION

Mother

To my mother, Mommy, you have been my backbone, my strength, my guidance, my everything, and I could not have completed this degree without you.

First Brother

To my first brother and friend, Boris, thank you for reminding me that life has no limits. You are my inspiration, and I am brave because of you.

Baby Brother

To my baby brother, E.J., you have been my light and joy.
You remind me that life is simple and happy.

Best Friend

To my best friend, Alexis, thank you for your attentiveness, your criticism, and your love.

Love Always,
Christal

Author's Statement Page

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Chapter 1

Introduction

1.1 Background

According to the Centers for Disease Control and Prevention (2016), the prevalence of childhood obesity currently lies at 17% in the United States alone. The prevalence of childhood obesity continues to increase each year (Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M., 2012). A 2007-2008 NHANES report, (2007) projected that 16.9% of children and adolescents between the ages of 2 and 19 years of age were obese. In addition, childhood obesity prevalence among preschool children between the ages of 2 and 5-year-old girls and boys reportedly increased from 5% to 10% between 1976-1980 and 2007-2008 and has increased from 6.5% to 19.6% among children aged 6 to 11 years of age. Data collected from the same period illustrates obesity in adolescents aged 12 to 19 increased from 5% to 18.1%. Moreover, Healthy People 2010 have ranked obesity as number one health problem. According to a health survey conducted in 2004, childhood obesity is common in United Kingdom, with obesity among 2 to 10 year-olds being at 14% and among 11 to 15-year olds at 15% (Karnik, S., & Kanekar, A., 2012).

Obesity generally is a result of an imbalance between energy intake and energy expenditure (Vaccaro, J., & Huffman, F., 2016). In order to have a convenient means of identifying those with obesity, the body mass index (BMI) has become the most popular method of screening for obesity (Pietrobelli, A., Faith, M. S., Allison, D. B., Gallagher, D., Chiumello, G., & Heymsfield, S. B., 1998). The BMI is a measure of body composition based on a person's weight in relation to his/her height. For children between the ages of 2 and 19, however, BMI is assessed as a percentile and plotted on the CDC growth chart. According to the CDC, obesity is defined as having a BMI (body mass index) of 30.0 or higher (CDC, 2016). Therefore, childhood

obesity is defined as having a BMI at or above the 95th percentile for the children of the same age and sex.

The increase of childhood obesity prevalence may have adverse morbidity and mortality implications in the adult life of the child (Karnik, S., & Kanekar, A., 2012). Children with obesity are at an increased risk of developing numerous obesity-related diseases, including liver disease, type 2 diabetes, heart disease, certain cancers, insulin resistance, orthopedic problems, and more (WHO, 2010). There are multiple factors that contribute to obesity in children, including genetic, behavioral, social, and environmental (Hamilton, K., Thomson, C., & White, K., 2013). Parental behaviors (i.e. rules about television use), access to technology and media in general, sibling influences, and general family habits all play a huge role in children's sedentary behaviors and physical activity levels (Pyper, E., Harrington, D., & Manson, H., 2016). Consequently, children with obesity often experience physical, psychological, and social health problems. Many government agencies and health organizations, therefore, have begun to put more focus on obesity in an effort to reverse it among children.

Studies have shown that children and adolescents are more likely to spend more time in sedentary activities such as watching television and playing games on the computer (O'Donovan, C., Roche, E. F., & Hussey, J., 2014). Adolescents with obesity are less likely to participate in traditional exercise and sports activities than children with a healthy weight (Simons-Morton, B., Eitel, P., & Small, M. L., 1999). The World Health Organization (2010) recommends decreasing inactivity in obese children. However, screen time is highly enjoyable, and one of the major factors that influence how children spend their time is how much they enjoy the activity (Dishman RK, Motl RW, Saunders R, et al., 2005).

Sedentary behaviors in children and adolescents have been linked to poor health outcomes in children and adolescents, such as cardiovascular disease, low self-esteem, type 2 diabetes, and social exclusion (Hinkley, T., Salmon, J. Okely, A. Trost, S., 2010). Sedentary behavior is any behavior that requires very little energy expenditure (Klitsie, T., Corder, K., Visscher, T. L. S., Atkin, A. J., Jones, A. P., & van Sluijs, E.,M.F., 2013). Some well-known examples/forms of sedentary behaviors include watching television, playing video games, and using the computer (Matthews, C. E., Chen, K. Y., Freedson, P. S., Buchowski, M. S., Beech, B. M., Pate, R. R., & Troiano, R. P., 2008).

U.S. National guidelines recommend that children engage in a minimum of an hour of moderate physical activity every day (O'Donovan, C., Roche, E. F., & Hussey, J., 2014). There are many different forms of physical activity (Gubbels, J. S., Dave H H Van, K., & Jansen, M. W. J., 2012). People can be active while at home, at work, within the community, and school. One be physically active through traditional active play, professional and recreational sports, general games, and/or physical education. There are many benefits to being physically active, including maintaining a healthy weight, maintaining strong muscles, maintaining coordination and balance skills, developing social skills through interactions with others, supporting proper brain function, and more (Colley, R. C., Garriguet, D., Adamo, K. B., Carson, V., Janssen, I., Timmons, B. W., & Tremblay, M. S., 2013). Unfortunately, the majority of adolescents do not meet these recommendations (Riddiford-Harland, D., Steele, J. R., Cliff, D. P., Okely, A. D., Morgan, P. J., & Baur, L. A., 2016). Research has shown that children engage in excessive sedentary behaviors due to advanced technology, decreased recess time at school, lack of access to playgrounds, and more (Stef P.J. Kremers, Marieke A.M. Dijkman, Judith SB, d. M., Jurg, M. E., & Brug, J., 2008). Studies have proven that sedentary behaviors have been associated with a

higher risk for chronic health problems such as obesity and diabetes and an increased likelihood of adult obesity (Seabra, A., Mendonça, D., Maia, J., Welk, G., Brustad, R., Fonseca, A. M., & Seabra, A. F., 2013). It is essential that modifiable factors are identified that would encourage children to engage in weight-related health behaviors.

1.2 Purpose of Study

The purpose of this study is to examine how low levels of physical activity and excessive screen time may contribute to obesity and sedentary behaviors in children and adolescents. In addition, it will examine how behaviors that are otherwise known to be sedentary (such as gaming) can be used to increase physical activity in this population. Moreover, it will expose the many health determinants (i.e. personal, social, and environmental factors) that influence both sedentary behaviors in children and the childhood obesity epidemic. Finally, this study will provide recommendations for decreasing sedentary behaviors among children and increasing levels of physical activity. It will do so by examining and applying theoretical based constructs that can be used to modify health behaviors and change social and environmental factors that are associated with obesity in children and adolescents. This study will also examine evidence related to efficacy of these approaches.

Chapter 2

Methods

This capstone project seeks to examine how sedentary activities such as screen time may contribute to childhood and adolescent obesity. In order to gather data on sedentary activities and childhood obesity, I conducted a systematic review of peer-reviewed published literature, simply referred to as a literature review. The purpose of this literature review is to provide a detailed overview of significant literature published sedentary behaviors among children and adolescents. This literature review examine various determinants of screen time and seek ways to leverage screen time to fight childhood obesity, specifically through the use of active video games.

In order to conduct the literature review, the problem of interest will be defined, which is the association of screen time and childhood obesity. Next, in order to identify articles of interest, databases including Pubmed, Academic Search Complete, Google Scholar, and Public Health Database will be used. Within these databases, I used the following search terms, keywords and phrases: sedentary; sedentary lifestyle; childhood obesity; obesity; screen time; screen time and obesity; screen time and nutrition; idol behaviors; active video games; parental influences on screen time; parental influences on obesity; burdens of childhood obesity; socioeconomic status and obesity; television use in homes; parental influence on television use; gaming to promote physical activity; physical activity recommendations; screen time recommendations; technology and obesity; social cognitive theory and childhood obesity; social cognitive theory and screen time. The literature review was conductef using all the databases listed above, over the course of two weeks in February 2017. The search was restricted by language (English only) but not by location, as evidence from around the world is relevant to prevention in the United States.

Using the Social Cognitive Theory to Influence Behavior Change

Examining theoretical determinants of childhood and adolescent obesity is essential to developing prevention strategies that can decrease the incidence and prevalence of childhood obesity. The Social Cognitive Theory (SCT) is a well-known theoretical framework for influencing and encouraging health behavior change (Young, M. D., Plotnikoff, R. C., Collins, C. E., Callister, R., & Morgan, P. J., 2014). It can be used to explain how sedentary behaviors in children can be influenced by internal factors such as the home and external factors such as the school and peers. The SCT can also be a valuable approach to influencing physical activity behaviors in adolescents (Murnan, J., Sharma, M., & Lin, D., 2007). Public health professionals should therefore consider the SCT this theoretical framework when constructing effective intervention strategies to combat and prevent childhood obesity. Thus, the SCT will be used as the primary theoretical framework for this Capstone project.

The key constructs of the Social Cognitive Theory related to individual behavior change are self-efficacy or a person's confidence in his or her ability to perform health protective behaviors, one's expectations about the outcomes of behavior change, and the goals one has for himself or herself (Sharma, M., Mehan, M. B., & Surabhi, S., 2010) . Physical and social outcomes will discussed throughout the Capstone. Physical outcomes that will be discussed include recreational settings, built environment such as sidewalks, and natural environment such as green space. Social outcomes that will be discussed include job opportunities for parents, safe housing, and availability of local stores with healthy food options. The SCT will thus be used to examine how its constructs can influence behavior changes in adolescents such as increasing levels of physical activity, decreasing television viewing, and transitioning from sedentary behaviors to active behaviors such as playing active video games.

Engaging in consistent physical activity is essential for physical and mental health. It is important to understand the correlates and determinants of physical activity, as this is a critical step to developing and implementing successful interventions. Evidence suggest that physical activity interventions based on a theoretical framework are more effective than a-theoretical approaches (Young, M. D., et al., 2014). The two primary constructs of the Social Cognitive Theory are self-efficacy (the belief and confidence one has to exercise control over their health behaviors) and outcome expectations (one's perception of the possible consequences that will occur as a result of engaging, or not engaging, in a particular behavior). Self-efficacy is considered the most significant contribution of the Social Cognitive Theory in literature. A review of literature was conducted to investigate three research questions: (1) What is the utility of Social Cognitive Theory to explain physical activity? (2) Is the effectiveness of SCT moderated by sample or methodological characteristics? (3) What is the frequency of significant associations between the core SCT constructs and PA? (Young, M. D., et al., 2014). 44 studies were retrieved from electronic databases containing 55 SCT models of physical activity. Results revealed that the SCT accounted for 31% variance in physical activity. Results also found that self-efficacy and goals were consistently associated with physical activity, although outcome expectations and socio-cultural factors were not. As shown in Table 1, 67 total self-efficacy variables were examined for associations with physical activity across 55 models. Out of the 67, 40 of the direct effects estimated from self-efficacy were statistically significant (60%). The significance of the total effect of self-efficacy on physical activity was also reported for 9 out of 25 self-efficacy variables (36%) (Young, M. D., et al., 2014).

Table 2 Frequency of significant association between SCT constructs and PA behaviour

Effect	SCT construct	Number of times				Significant effect ratios	
		Construct included in models	Effect estimated	*P* value reported	Effect significant ($P < 0.05$)	Significant/ Estimated (%)	Significant/ Reported (%)
Direct effect*†	Self-efficacy	67	67	67	40	60	60
	Outcome expectations	71	70	70	21	30	30
	Goals						
	Self-regulation	23	23	23	16	70	70
	Goal/Intention	7	7	7	6	86	86
	Socio-structural factors						
	Impediments	24	21	21	5	24	24
	Social support	40	30	30	6	20	20
	Environment	38	38	38	6	16	16
Total indirect effect‡	Self-efficacy	67	25	9	4	16	44
	Outcome expectations	71	29	9	3	10	33
	Goals						
	Self-regulation	23	0	–	–	–	–
	Goal/Intention	7	0	–	–	–	–
	Socio-structural factors						
	Impediments	24	10	3	1	10	33
	Social support	40	18	7	6	33	86
	Environment	38	1	0	–	0	–
Total effect§	Self-efficacy	67	25	9	6	24	67
	Outcome expectations	71	35	15	4	11	27
	Goals						
	Self-regulation	23	12	12	10	83	83
	Goal / Intention	7	4	4	4	100	100
	Socio-structural factors						
	Impediments	24	12	5	2	17	40
	Social support	40	18	7	6	33	86
	Environment	38	1	0	–	0	–

*β estimates from multiple regression models were considered as 'direct effects' for this analysis. Data from multiple regression models represented: 42/67 self-efficacy effects (63%), 35/71 outcome expectations effects (49%), 3/7 goal/intention effects (43%), 11/23 self-regulation effects (48%), 12/24 impediments effects (50%) and 22/40 social support effects (55%).

†The unique effect the variable has on the outcome (i.e. the effect that is unmediated by any other variable in the model).

‡The total effect of a construct on PA via its influence on other constructs in the model (i.e. sum of mediated effects to PA in model).

§Sum of the direct effects plus indirect effects (i.e. the total effect of the variable on the outcome, directly and through other constructs).

– (en dash), not applicable; PA, physical activity; SCT, social cognitive theory.

Chapter 3

Literature Review

This chapter reviews literature on sedentary behaviors and screen time and their association to childhood and adolescent obesity. In conducting this review, the literature revealed four major themes. Firstly, benefits of physical activity among both the general population and children were examined. Secondly, some of the major drivers of sedentary behaviors are parental influence and socioeconomic status. Thirdly, it examines the most common activities that children and adolescents spend most of their time engaging in, such as social media, cell phone, television, and computer use. Finally, the review examines ways to reduce sedentary behaviors and increase physical activity among children and adolescents, particularly through the use of active video games.

3.1 Benefits of Physical Activity

Physical activity is essential to overall mental and physical health. Increasing physical activity levels can result in better fitness levels, a higher self-esteem and self-confidence, and better mental health (Bendíková, E., 2014). The World Health Organization (WHO) defines physical activity as "any bodily movement produced by skeletal muscles that requires energy expenditure." Physical inactivity is considered a leading risk factor for global mortality, causing about 3.2 million deaths globally (WHO, n.d.). Some benefits of physical activity include maintaining a healthy body weight, having better sleep, body image enhancement, stable blood pressure levels, stable blood glucose levels, a healthy immune system, an improved metabolism, and more. Moderate to vigorous levels of physical activity have also been linked to a lower chance of developing chronic diseases (Bendíková, E., 2014).

Researchers conducted a study to estimate the long-term effects of physical activity on mortality and cardiovascular disease (Shortreed, S. M., Peeters, A., & Forbes, A. B., 2013). They

used 4,729 participants from the Framingham Heart Study that were alive and free of cardiovascular disease in 1956. The study was conducted by measuring physical activity at three visits over 30-year period with a variety of risk factors for cardiovascular disease. Cumulative physical activity was determined by either a person being active long-term or a person being inactive long-term. The main outcome measures were incidence of cardiovascular disease, all-cause mortality, and cardiovascular disease-attributable mortality. Results of the study showed that cumulative long-term physical activity had a protective effect on cardiovascular disease incidence and all-cause mortality incidence. Results also showed that long-term physical activity in men, but not women, appeared to have a protective outcome on cardiovascular disease incidence (p value=0.004). Thus, increased levels of physical activity have a positive effect on mortality rate and cardiovascular disease (Shortreed, S. M., et al., 2013).

Using data from the Framingham Heart Study, researchers conducted a study to assess the association between physical activity and a reduced risk of developing diabetes and reduced mortality among diabetic patients (Jonker, J. T., De Laet, C., Franco, O. H., Peeters, A., & al, e., 2006). They constructed multistate life tables for men and women starting at the age of 50. The researchers determined transition rates by level of physical activity for three transitions: non-diabetic to death, non-diabetes to diabetes, and diabetes to death. They used hazard ratios related to different levels of physical activity levels after adjusting for sex, age, and possible confounders. Results showed that increased levels of physical activity were associated with lower rates of incidence of diabetes. Specifically, at age 40, life expectancy diabetes-free was 2.3 years longer for moderately active people and at least 4 years longer for highly active people. Results also showed that the subjects; risk of mortality was inversely associated with levels of physical activity. Overall, the researchers concluded that moderately and highly active people

have a longer life span and spend more years without diabetes than people with low levels of physical activity (Jonker, J. T., et al., 2006).

Physical inactivity is considered a public health burden during adolescent years, which is a foundational period of a person's development of health behaviors. Physical activity levels among adolescents in the United States is below recommended levels (Janssen, I., & LeBlanc, A. G., 2010). Decreased levels of physical activity among adolescents are considered to be a major contributor to increased rates of childhood obesity. Public health interventions, therefore, should be developed to promote increased levels of physical activity in children and adolescents. It is also important for interventions to focus on the decline in physical activity during the transition from childhood to adolescence (Hendriks, A., Habraken, J. M., Kremers, S. J., Jansen, M. J., Oers, H. v., & Schuit, A. J., 2016). There are many benefits to physical activity for adolescents. According to the CDC (2015), regular physical activity among adolescents can help reduce the risk of developing chronic diseases such as cardiovascular disease and diabetes, maintain a healthy weight, maintain healthy muscles and bones, combat depression and anxiety, promote psychological well-being, and improve academic performance.

Researchers conducted a cross sectional analysis on 5,500 12-year-old children enrolled in a The Avon Longitudinal Study of Parents and Children in order to determine an association between physical activity and obesity (Ness AR, Leary SD, Mattocks C, Blair SN, Reilly JJ, Wells J, et al., 2007). The researchers measured physical activity by having participants wear an actigraph—a device that tracks physical activity—for at least ten hours per day and at least three days a week. The variables used were total physical activity and vigorous physical activity. Total physical activity was the total amount of physical activity and included different intensity levels of activity. Vigorous physical activity was measured as the average amount of minutes per day.

Researchers also took into account confounding factors such as parental education level, social class, birthweight, gestational age, smoking of mother in pregnancy, and obesity of mother during pregnancy. Results illustrated a strong inverse association between physical activity and obesity, although it was stronger in boys than girls. Results also showed that higher intensity physical activity may be more beneficial than total physical activity ((Ness AR, et al., 2007).

In a study conducted to investigate the association between indices of insulin resistance and childhood obesity, researchers used 3,348 preadolescent children between the ages of 3 and 10 from the IDEFICS (Identiflcation and prevention of dietary and lifestyle-induced health effects in children and infants) cohort study (Peplies, J., Börnhorst, C., Günther, K., Fraterman, A., Russo, P., Veidebaum, T., & ... Ahrens, W., 2016). The children were observed from 2007 to 2010. Lifestyle indices, specifically objectively determined physical activity, were considered as determinants of insulin resistance. Physical activity was recorded by using accelerometers. Results from the study indicated that there is a strong association between insulin resistance and weight gain in adolescents. The data also showed that physical inactivity and sedentary behaviors are associated with insulin resistance development and, thus, interventions should be focused on promoting moderate to high levels of physical activity (Peplies, J., et al., 2016).

Researchers were interested in the possible association between playing video games and cognitive performance among adolescents (Adachi, P. J., C., & Willoughby, T., 2013). They hypothesized that certain types of video games may predict an increase in certain cognitive skills, such as problem solving. They believed that strategy games may help the player gather information and then strategize before trying to solve a particular problem. Thus, researchers used a sample of 1,492 adolescents (about half female and male) and studied them over the four year period in high school. Results of the study illustrated that adolescents that played more

strategic video games reported overall better problem solving skills. Results also showed an association between video game play and higher academic grades. Researchers believed that this association was due to the fact that strategic video game play was a prediction of higher self-reported problem solving skills, and thus predicted higher academic grades (Adachi, P. J., et al, 2013).

3.2 Drivers of Sedentary Behavior

3.2a Parental Influence on Sedentary Behavior

There are many drivers of sedentary behavior among children and adolescents. In order to develop effective interventions and strategies for combatting this epidemic, health professionals must analyze the social, environmental, psychological, and economic factors that might influence unhealthy behaviors. The home has consistently been identified as a key influence on physical activity and screen time (Smith, B. J., Grunseit, A., Hardy, L. L., King, L., Wolfenden, L., & Milat, A., 2010). Studies have shown that the level of support that parents provide and whether or not they serve as positive role models can have an impact on physical activity and screen time levels in children. Parents play a significant role in their children's exposure to factors that can either be considered as barriers or enablers to the level of activity their children engage in. Some examples include the cost it takes to finance participation in sports and exercise equipment, parental guidelines and limitations, access to transportation to attend and take children to activities, and whether they make television and other screen time activities available to children, and to what extent.

While parents are considered to be key influencers on the development of early obesity promoting and protective behaviors, there has been limited research on parental self-efficacy in the domain of childhood obesity (Yap, S. T., & Baharudin, R, 2016). Self-efficacy is defined as

the confidence one has to perform a certain behavior, and it is known to be a strong predictor of the maintenance of protective health behaviors (Campbell, K., Hesketh, K., Silverii, A., & Abbott, G., 2010). It is important to consider and examine the association between parental self-efficacy and sedentary behaviors in children and adolescents. Research suggests that maternal self-efficacy may be an important correlate of the level of screen time children engage in (Yap, S. T., & Baharudin, R, 2016). Thus, if a parent has a higher self-efficacy to promote moderate levels of physical activity, it is likely that their children will engage in activities and have a lower risk of becoming obese or engaging in sedentary behaviors (Warschburger, P., & Kühne, D., 2014). For example, studies show that late bedtime habits are associated with high levels of screen time in children (Ogunleye, A. A., Voss, C., & Sandercock, G. R., 2015). Because parents can take on the authority to enforce bedtimes and screen time use, they have the ability to play a key role in reducing screen time use in children.

A study published in the 2007 National Survey of Children's Health examined potential determinants of obesity in children and found that excessive television use (more than 2 hours per day) is linked to weight gain (Wethington, H., Pan, L., & Sherry, B., 2013). The American Academy of Pediatrics recommends that children over the age of 2 not engage in television viewing for more than 2 hours a day, and that parents should not place a television in a child's bedroom (Bar-on, M., 1999). Despite these recommendations, children and adolescents continue to exceed the recommendations, and one of the reasons identified in literature is the use of televisions in the bedroom (Dennison, B. A., Erb, T. A., & Jenkins, P. L., 2002). The national survey discussed above found that adolescents from the years of 12 to 17 greatly exceed screen time recommendations. In addition, it concluded that having a television in the bedroom is indeed associated with childhood obesity (Dennison, B. A., et al., 2002). It is essential for

parents to use their authority to limit the amount of television that their children watch per day, thus reducing both their screen time and risk for childhood and adult obesity.

Physical activity among children and adolescents may either be encouraged or inhibited by parents' behaviors and the home environment in general (Hodges, E. A., 2003). Evidence suggests that targeting parents' behaviors may serve as a key strategy to increasing physical activity levels among children (Pyper, E., Harrington, D., & Manson, H., 2016). Many parents are already aware of the many benefits physical activity will have for their children. Thus, when parents' attitudes about sedentary behavior and levels of physical activity are improved, there is a better chance for children to adopt those health protective behaviors (Tandon, P. S., Zhou, C., Sallis, J. F., Cain, K. L., Frank, L. D., & Saelens, B. E., 2012). There are many parental behaviors that have been associated with encouraging physical activities among children. One study suggested that parents engaging in physical activities in the presence of their children can encourage their children to engage in physical activities (Hamilton, K., Thomson, C., & White, K., 2013). Research shows that positive reinforcement, such as encouragement to join sports activities, buying sports equipment, and providing a means of transportation for extracurricular activities are some ways to significantly increase a child's physical activity levels (Eagle, T. F., Sheetz, A., Gurm, R., Woodward, A. C., Kline-Rogers, E., Leibowitz, R., Eagle, K. A., 2012).

3.2b Socioeconomic Status and Sedentary Behaviors in Children with Obesity

Studies have shown that there is an association between lower socioeconomic status (SES) and poor health in children and adolescents (Tandon, P. S., Zhou, C., Sallis, J. F., Cain, K. L., Frank, L. D., & Saelens, B. E., 2012). A child's socioeconomic status has the ability to influence disease risks in their adulthood and increase the chances of adult health disparities (Coombs, N., Shelton, N., Rowlands, A., & Stamatakis, E., 2013). Children in lower

socioeconomic households in the United States and other developed countries have a higher chance of being obese (Mcmurray, R. G., Harrell, J. S., Deng, S., Bradley, C. B., Cox, L. M., & Bangdiwala, S. I., 2000). Screen time is a major determinant of obesity among adolescents, and socioeconomic status influences screen time (Hankonen, N., Heino, M. J., Kujala, E., Hynynen, S., Absetz, P., Araújo-Soares, V., & Haukkala, A., 2017). Multiple factors should be considered when examining the relationship between weight status among children and socioeconomic status (Coombs, N. et al., 2013). Some socioeconomic factors that will be discussed in this section include income, physical environment, and level of education.

One major socioeconomic factor that may influence screen time in adolescents is income (Coombs, N. et al., 2013). Research shows that families with a low income typically have limited access to healthy food options and opportunities to engage in physical activity (Babey, S. H., PhD., Hastert, T. A., M.P.P., Wolstein, J., M.P.P., & Diamant, Allison L,M.D., M.S.H.S., 2010). Low-income neighborhoods generally do not have affordable healthy food options in the surrounding area (Schmeer, K. K., 2010). Communities of a lower socioeconomic status normally do not have green space and sidewalks, and recreation centers and parks are often perceived as unsafe (Eagle, T. F., Sheetz, A., Gurm, R., Woodward, A. C., Kline-Rogers, E., Leibowitz, R., . . . Eagle, K. A., 2012). Many households of low economic status usually have a parent or parents that work demanding or time consuming jobs throughout the week, and thus need something to keep their children either distracted or entertained (Appelhans, B. M., Fitzpatrick, S. L., Li, H., Cail, V., Waring, M. E., Schneider, K. L., . . . Pagoto, S. L., 2014). Parents must be able to provide an appropriate environment for physical activity or access to these facilities in order for children to be able to engage in physical activity.

Studies have shown that parents of low socioeconomic status generally do not have a high level of education (James, S. A., Fowler-Brown, A., Raghunathan, T. E., & John, V. H., 2006). Although evidence suggests that children and adolescents with parents of low socioeconomic status spend more time engaging in sedentary behaviors than their counterparts, the mechanisms responsible for these key differences are poorly understood (Gebremariam, M. K., Altenburg, T. M., Lakerveld, J., Andersen, L. F., Stronks, K., Chinapaw, M. J., & Lien, N., 2015). A study in a journal known as "Obesity Reviews" sought to understand some of these key differences. The study found that parental education was inversely associated with their views on having meals while watching television in two out of the three studies (Gebremariam, M. K., et al., 2015). Moreover, the researchers found that parental education was inversely associated with their regulations about television content that their children are exposed to in three out of the three studies. The study found that parental education was also inversely associated with the presence of a television in the bedroom in eight out of the eleven studies.

In examining determinants related to childhood obesity, researchers conducted a study to examine associations between socioeconomic status, gender, weight status, and children's engaging in sedentary behaviors and sports (Fairclough, S. J., Boddy, L. M., Hackett, A. F., & Stratton, G., 2009). They did so by conducting lifestyle questionnaires among 6,337 adolescents aged 9-10 years of age. Results from the study revealed that 47.9% of children who watched more than an hour of television of day came from lower socioeconomic groups in comparison to the 41% of children who came from a higher socioeconomic status ($p<0.001$). The largest proportion of children who played video games for more than an hour on weekdays also came from lower socioeconomic groups in comparison to their counterparts ($p<0.001$). The study revealed that 23.2% of overweight children reported using the internet for more than an hour a

day in comparison to 17.5% of normal weight children ($p<0.001$). Results revealed that sports participation was also significantly associated with weight and socioeconomic status, with overweight children and those of a lower socioeconomic status reporting less participation in sports ($p<0.001$). The study reported lower socioeconomic status was associated with increased weight gain and a higher level of screen time activities such as watching television, playing video games, and using the Internet (Fairclough, S. J., et al., 2009).

3.3 How Children and Adolescents Spend Most Their Time

3.3a Media Use in Children and Adolescents

In this day and time, technology serves as a significant daily part of children's lives (Smahel, D., Wright, M., & Cernikova, M., 2015). As a result, public health professionals have begun researching the association between technology usage and poor health outcomes in children and adolescents. Some health-related consequences that have been linked to media use include weight gain and obesity, emotional instability, depression, mental health issues, lonliness, anxiety, and impulsivity (Augner C, Hacker GW, 2012).

A study regarding social media use in adolescents found that social media was problematic, accounting for low self-esteem, depressive symptoms, and social withdrawal (Bányai, F., Zsila, Á., Király, O., Maraz, A., Elekes, Z., Griffiths, M., Demetrovics, Z., 2017). A researcher found that mobile technologies among children and adolescents is on the rise, including use of tablets, e-readers, handheld video game devices, and smart phones (Coleman, T., 2014). The researcher took a national sample of 1,550 parents with at least one child aged 17 or younger to examine the effect of media use among adolescents. The study found that technology in children's bedroom, such as televisions and computers, served as a big contributor to media usage among children and adolescents. Finally, the study found that as children's age

increases, so does their use of electronics and media (Coleman, T., 2014). The Australian Government Department of Health and Aging found that children aged 10-13 years old engage in media use on an average of 4 hours per day (Mathers, M., Canterford, L., Olds, T., Hesketh, K., Ridley, K., & Wake, M., 2009). They also found that television use is the most prevalent leisure activity and is watched by at least 98% of children and adolescents aged 5 to 14 years of age. In Table 2 below, media use is shown, represented in minutes per day.

Table 2: Amount of time adolescents spend on different types of media.

Time (Minutes per day)	
Type of Media	***Mean ± Standard Deviation***
Television	128.3±80.9
Computer	19.3 ± 33.8
Video Games	35.2 ± 65.0
Telephone	13.4 ± 23.2

3.4 Reducing Sedentary Behavior through the Use of Active Video Games

A large contributor to obesity among adolescents is the use of video games (Simons, M., Chinapaw, M. J. M., Van, D. B., de Boer, M.,R., Seidell, J. C., Brug, J., & de Vet, E.,2014). Video games have traditionally been known to be a sedentary activity (O'Donovan, C., Roche, E. F., & Hussey, J., 2014). Original gaming systems simply involved a player sitting idly in front of the television while playing a game for hours at a time. Thus, the introduction of active video games can potentially hold promise as a key intervention tool for increasing physical activity levels and combatting obesity (Chaput, J. P., Tremblay, A., Pereira, B., Boirie, Y., Duclos, M., & Thivel, D., 2016). In recent years, active video games have been introduced and are believed to increase physical activity and decrease sedentary behavior among children (Simons, M., et al.,

2015). This is due to the fact that active video games increase overall energy expenditure, thus causing players to exert more energy while playing. There is an essential need for public health professionals to take advantage of the possible benefits that video games can have in increasing activity levels and reducing sedentary behaviors. Thus, active video games have the potential to symbolize a fun exercise tool for children and adolescents with obesity (Simons, M., et al, 2014).

Children are motivated to play video games because it provides immediate enjoyment (Dishman RK, et al., 2005). Researchers conducted a study based on the social cognitive theory that examined the psychological motivations of Taiwanese adolescents that play online video games (Chin-Sheng, W., & Wen-Bin Chiou., 2007). The researchers conducted two studies within their research; Study 1 focused on the different motivations between adolescents that were addicted to playing video games and adolescents that were not addicted to playing video games. Study 2 examined four factors that moderate the serious effect of extrinsic motivators (doing something for external rewards) on intrinsic motivation (doing something because you enjoy it) to determine whether they would function as predicted. Researchers found that extrinsic rewards undermined intrinsic motivation when they were tangible, high expectancy, high relevance, and non-contingent. This also meant that players' intrinsic motivation increased when extrinsic rewards were intangible, low expectancy, low relevance, and contingent. Thus, it is important for health professionals, parents, teachers, and other influential authority figures to strategize on ways that children can find enjoyment in being more physically active.

Physical activity has multiple correlates, and motivation is an important one to consider when assessing sedentary behaviors in adolescents. Researchers were interested in evaluating the effect of a weekly active video game class on the motivation of children between the ages of 9 and 12 years old (Chin A Paw, Marijke J. M., Jacobs, Wietske M., Vaessen, Ellen P. G., Titze,

Sylvia, & Mechelen, Willem Van, 2008). They developed a pilot study in which the children played an interactive dance simulation video game at home over a 12-week period. Researchers randomly assigned 27 children to a home group instructed to play the interactive video game at home. They assessed motivation to play the active video game based on the duration that the children played in minutes and dropout throughout the study. Results from the study showed that multiplayer classes significantly (P=0.02) increased children's motivation to play active video games.

With the increase in childhood obesity, the introduction and application of video game technologies have risen. Technology that incorporates physical activity with video games is commonly referred to as "exerlearning" (Mellecker, R. R., Witherspoon, L., & Watterson, T., 2013). Research on video games targeted at increasing physical activity levels among children and adolescents uses active video games, also known as "exergames". The purpose of exergames is to incorporate physical activity while playing the games, including fancy footwork, swift hand motions, and full body moves. A study was conducted to explore the impact of exergaming on in-class physical activity and children's motivation to engage in exergaming (Sun, H., 2012). Researchers conducted the study at an elementary school, in which elementary school students participated in a 4-week exergaming unit and a 4-week fitness unit. Results from the study illustrated that students' situational interest in exergaming was significantly higher ($P<0.01$) than in the fitness unit at the beginning and end of instruction, showing that students enjoy exergaming more than traditional physical activity in the school setting. The evidence suggests that exergames may have strong motivational power for adolescents, so public health interventions should be incorporate exergaming. Studies have suggested that if video game technologies incorporate physical activity, exercise will seem more attractive to children and,

thus, decrease their levels of sedentary activity. These advances in technology have brought forth the collaboration of physical activity with video game technology, thus giving children the opportunity to not only learn new concepts while engaging in the video game, but also become more active as a result of it (Sun, H., 2012).

3.4a Active Video Games May Help Decrease Energy Intake among Adolescents

Adolescents tend to consume more calories during and after playing video games, raising concerns that sedentary behaviors such as the use of video games may encourage weight gain (Allsop, S., Dodd-Reynolds, C., Green, B. P., Debuse, D., & Rumbold, P. L. S., 2015). The increased prevalence of video game use has been linked to an increase in body weight, which has prompted researchers to examine the effect that video games have on obesity. This is due to the fact that video games are known to be sedentary. The use of video games—specifically sedentary or seated ones—is often accompanied by energy input, or food consumption, thus increasing the user's chance of being obese in the future. Another reason adolescents generally consume more calories while playing video games is that food is viewed as a reward, and not simply a means of satisfying hunger (Allsop, S., et al, 2015).

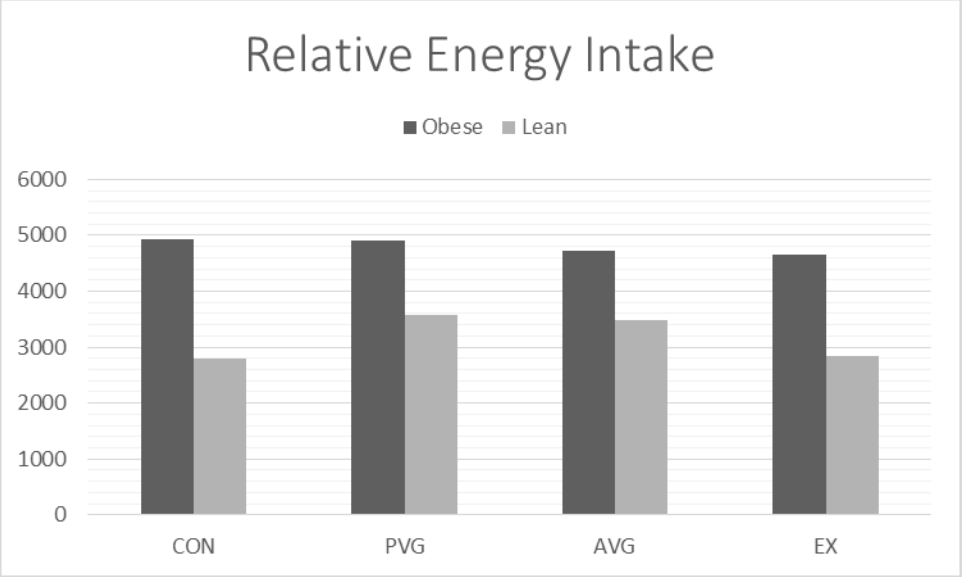
A study was conducted among 8-11-year-old boys to test the effects of active and sedentary video games on energy intake and energy expenditure (Allsop, S., Green, B. P., Dodd-Reynolds, C., Barry, G., & Rumbold, P. L. S., 2016). The researchers directed a randomized controlled trial on 22 boys by having them complete one 90-minute interactive video cycling gaming session and one 90-minute sedentary video gaming session, during which food and drinks were provided for both. Table 2 below displays gaming energy intake, physical activity levels, energy expenditure and more between the sedentary and active video gaming sessions. In the post-gaming test, researchers found that estimated energy expenditure was significantly

higher during active video gaming (P<0.001). The mean for physical activity levels was significantly higher in the active video gaming session than the sedentary video gaming session (P<0.001). Energy intake levels were significantly higher in the sedentary video gaming session than the active video gaming session. Overall, active video games provide better effect on energy balance than sedentary video games (Allsop, S., et al., 2015).

Research was conducted on food intake response to exercise and active video gaming in lean and obese adolescents in order to determine the effect the sedentary and active video gaming (Chaput, J. P., Tremblay, A., Pereira, B., Boirie, Y., Duclos, M., & Thivel, D., 2016). Specifically, researchers wanted to know whether active video games and exercise influenced food consumption in youth differently. Thus, they conducted a study among 24 adolescent boys (twelve lean and twelve obese between the ages of 12 and 15 years old) in which the boys were required to complete four 1-hour sessions in a cross-over design study. The following are the four groups that the participating boys could be placed in: control (CON; sitting), passive—or sedentary—video game (PVG; boxing game), active video game (AVG; boxing game on Xbox Kinect), and exercise (EX; cycling).

As illustrated in Figure 1 below, results showed that overall energy intake was highest with the CON (sedentary) group, while it was the lowest in both the AVG (active video gaming) and EX (exercise) groups. Statistical analysis revealed a significant condition effect for all four groups (P<0.05). Furthermore, results showed that obese adolescents had an overall higher energy intake in all four conditions than lean adolescents (Chaput, J. P. et al., 2016). It is essential that public health professionals, school officials, parents, and other authorities work to combat obesity through leveraging ways to decrease energy intake levels and increase physical activity exercises among adolescents.

Figure 1. Relative energy intake among obese and lean adolescent boys while sitting (CON), playing a boxing game (PVG), playing a kinetic boxing game (AVG), and exercising (EX).



Note: Chaput, J. P., Tremblay, A., Pereira, B., Boirie, Y., Duclos, M., & Thivel, D. (2016). *Relative energy intake among obese and lean adolescent boys The British Journal of Nutrition, 115*(3), 547-553.

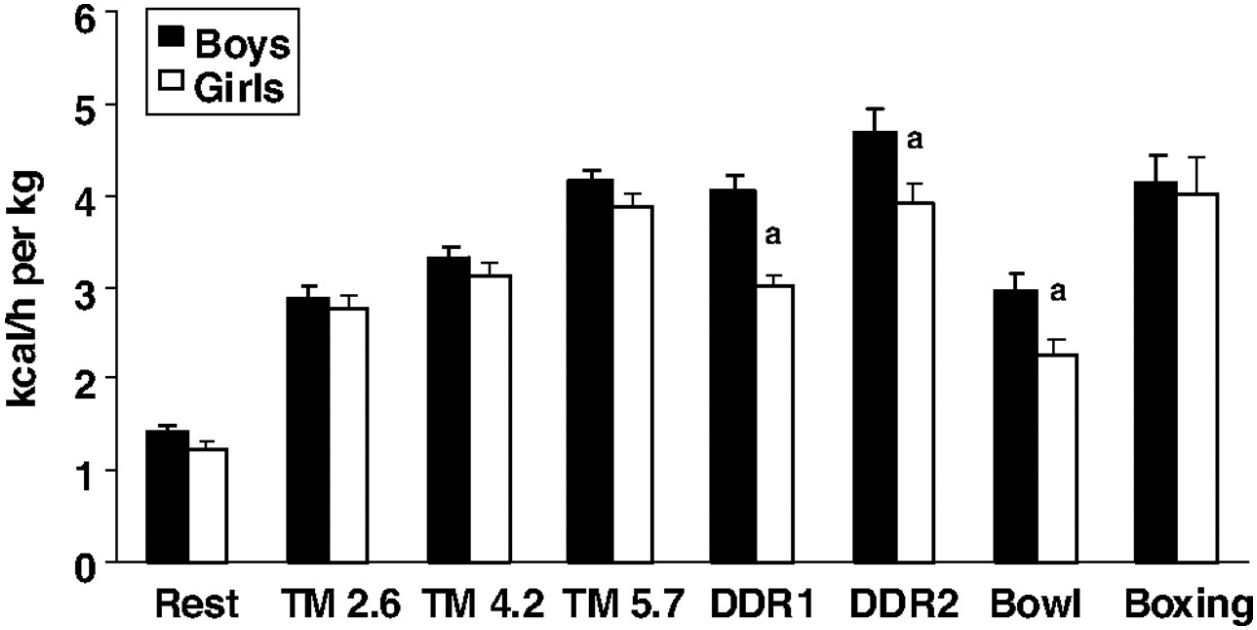
3.4b Active Video Games as a Leverage to Increase Physical Activity Levels

Moderate levels physical activity plays an essential role in the prevention of many chronic diseases, including type 2 diabetes, cardiovascular disease, and even some types of cancers (Krause, J. M., & Benavidez, E. A., 2014). Despite the known importance of engaging in physical activity, most people in America fail to meet the minimum requirements. According to (WHO, n.d.), children and adolescents should engage in a minimum of 60 minutes of moderate to vigorous physical activity on a daily basis. The physical activity should be aerobic (requiring free oxygen and improving the cardiovascular system's efficiency) and activities/exercises should be included that incorporate strength training. WHO also states that exceeding the minimum requirements for physical activity provide even greater health benefits.

Researchers conducted a study among 14 boys and 9 girls between the ages of 10 and 13 years old in order to compare energy expenditure rates in children playing active video games

(Graf, D. L., Pratt, L. V., Hester, C. N., & Short, K. R., 2009). They used the following games for the study: Dance Dance Revolutation (DDR) on a Sony Playstation 2 game system and Nintendo's Wii Sports. The specific activities that the participants engaged in were walking on a treadmill (Wii), dancing on a pressure-sensitive mat (DDR), and boxing and bowling (Wii). Researchers measured energy expenditure, heart rate, step rate, and perceived exertion, which was all conducted in a lab setting. Results showed that walking on a treadmill resulted in a significant increase in energy expenditure ($P<0.05$). The boxing and bowling games also showed a significant increase in energy expenditure. Dance Dance Revolution 2, however, showed the highest rate of energy expenditure (Graf, D. L., et al., 2009). Figure 2 below illustrates results from the study.

Figure 2. Step rate during Wii bowling and boxing, walking on treadmill (Wii), and Dance Dance Revolution (DDR Treadmill Walking (TM) velocities were 2.6, 4.2, and 5.7 km/hr



Note: Graf, D. L., Pratt, L. V., Hester, C. N., & Short, K. R. (2009). Step rate according to different active video game exercises. Retrieved April 11, 2017, from http://pediatrics.aappublications.org/content/124/2/534.short

Researchers conducted a cross-sectional study among 34 participants in order to understand the correlation between technology and enjoyment (or lack thereof) while exercising (Monedero, J., Lyons, E. J., & O'Gorman, D.,J., 2015). The purpose of the study was to compare physiological, perceptual, and enjoyment responses between one session of conventional cycling and one session of an interactive cycling video game with the same workload. In order to assess enjoyment among participants, researchers required them to fill out a PACES scale after 10, 20, and 30 minutes of each of the trials. Statistical analysis was conducted and results revealed a significant effect on the enjoyment scale. Results showed that participants reported significantly higher levels of enjoyment during the interactive cycling video game than the conventional cycling ($P<0.001$). Table 3 below illustrates the enjoyment and ratings of perceived exertions (RPE) scores during both the conventional cycling and interactive video game cycling trials.

Table 3. Enjoyment responses to Conventional Cycling and Interactive Video Game Cycling
**P<0.05 represents a significant difference*

	Conventional Cycling	*Interactive Video Game Cycling*
	Total	*Total*
Enjoyment (%)		
10 minutes	*45 ±13.5*	*69.3 ±14*
20 minutes	*40 ±14*	*64 ±14.5*
30 minutes	*37 ±15.5*	*63.4 ±17*

Note: Monedero, J., Lyons, E. J., & O'Gorman, D.,J. (2015). Enjoyment responses to Conventional Cycling and Interactive Video Game Cycling.

In order to test the hypothesis that children and adults lose more calories while playing active video games compared to sedentary video games, researchers conducted a single-group study (Lanningham-Foster, Lorraine PhD, Foster, Randal C. BS, McCrady, Shelly K. MS,

Jenson, Teresa B. MD, Mitre, Naim MD, & Levine, James A. MD PhD, 2009). The study was comprised of 22 children (11 female and 11 male) and 20 adults (10 female and 10 male), both in good health condition. Researchers measured energy expenditure of participants while they were standing, resting, watching television in a seated position, playing a traditional sedentary video game, and playing an active video game (Nintendo Wii Boxing).They used accelerometers to measure physical activity levels, and energy expenditure was measured with a calorimeter (a device used to determine changes in energy). Results illustrated that energy expenditure was significantly greater ($P<0.001$) when children or adults played active video games than all other activities (Lanningham-Foster, Lorraine PhD, et al., 2009).

Chapter 4

Summary and Recommendations

Childhood obesity is a global epidemic, and is expected to increase the rates of many chronic diseases, including heart disease, stroke, diabetes, and more (Frieden, T., Dietz, W., & Collins, J., 2010). The Centers for Disease Control and Prevention (2009) estimates that more than one in six children in the United States are obese, which is three times the rate in the 1970's. This Capstone project examined the association between childhood and adolescent obesity and sedentary behaviors, specifically screen time. Research findings in this Capstone identified sedentary behaviors (watching television, playing video games, using the computer, using media devices, etc.) as a major public health issue. Data are clear and suggest that there is evidence that sedentary behavior is a major contributor to obesity among children and adolescents (Matthews, C. E., et al., 2008). Some of the main drivers of sedentary behaviors among children include parental influence (Smith, B. et al., 2010), socioeconomic status (Tandon, P. et al., 2012), and media use (Smahel, D., et al., 2015).

The literature review revealed some approaches to combatting sedentary behaviors among children and adolescents. Research revealed that the use of video games—normally considered a sedentary activity—may help reduce sedentary behaviors and increase physical activity among children (Simons, M., et al., 2015). It is evident from this Capstone project that multiple entities are needed to promote physical activity among children and adolescents and decrease sedentary behaviors. The Social Cognitive theory is an excellent framework to consider when developing interventions focused on such efforts. Individual lifestyle factors, such as exercise and eating a balanced diet, are essential to change. However, since children are generally governed by parents, caregivers, school officials, etc., their self-efficacy will highly depend on these particular groups of people. Parents/guardians and school officials serve as

primary role models for adolescents, since they spend the majority of their waking hours either at home or in school (Graf, C., Beneke, R., Bloch, W., Bucksch, J., Dordel, S., Eiser, S., . . . Woll, A., 2014). In the home and school setting, they should encourage children to be active by introducing them to the benefits of physical activity as early as possible. Environments such as day care centers and after-school programs should offer multiple structured exercise periods throughout the day, such as two 30-minute recess breaks or four 15-minute recess breaks. Parents should avoid allowing children to have a television in their bedroom, and limits should be placed on television use based on age (Graf, C., 2014). For example, adolescents 12-years-old and under should be limited to only 1 hour of television use per day. Children in early care settings (ages 2 -5) should be targeted in order to prevent the onset of childhood obesity (ECE, 2016). According to the CDC (2016), more than 60% of children under the age of 6 spend an average of 30 hours per week in a non-parental care setting. This is due to the fact that many parents work full time (at least 40 hours a week). Elementary and middle schools, after school programs, and recreational centers should work to promote physical activity in children/adolescents between the ages of 5 and 12. This is an essential time period of a child's life, as it is a transition from childhood to adolescence. School officials can promote physical activity by providing more than an hour of recess/physical education during school hours. Adolescents/teenagers between the ages of 13 and 19 should be targeted for obesity prevention as well. This age group can be particularly difficult to target since habits (positive or negative) have likely been formed during adolescent years. High schools play a pivotal role in this target group simply because adolescents spend the majority of their time in school during the day. School officials can use sports activities, physical education classes, and even extracurricular clubs/organizations to promote physical activity. Children and adolescents are also more likely to engage in active video games

than traditional exercise. Active video games that seem to be the most popular include Nintendo Wii Sports (boxing, swimming, running on the treadmill, etc.), Dance Dance Revolution, and Kinect Adventures.

Because media plays a significant role in children and adolescents' daily lives, it is important to use the media as a strategy to increase physical activity levels. Community-wide campaigns can serve as an excellent intervention strategy to influence children and adolescents. Community campaigns deliver messages by using the media such as television, social media, radio, and trailers in movie theaters (CDC, 2011). These particular campaigns are normally large-scale campaigns that are characterized by a "brand" message or tagline that is used repeatedly to get and the target audience's attention. Community-wide campaigns can include components such as self-help groups, school fairs, risk factor screening, policy changes and environmental changes, such as creating better access to walking trails and recreational facilities, and more. For purposes of this Capstone, media campaigns will serve as the focus intervention strategy.

According to U.S. recommendations for physical activity, youth should get engage in no less than 1 hour of physical activity a day. Walking can serve as a great way to help children and adolescents get the daily recommended physical activity levels, as it is gentle on the joints and can be done in many places. The community could use a media campaign to target children and adolescents and encourage them to walk. The community has had success with such a campaign in the past. Wheeling Walks was a successful community campaigned that used paid media to encourage walking among sedentary older adults (Reger, B., 2002). It was a quasi-experimental communication intervention that used the theory of planned behavior and trans theoretical model constructs to influence and alter behavior by promoting a minimum of 30-minute daily walks.

Organizers promoted this campaign through paid media, public relations, and public health events. Program impact was determined by pre and post-intervention surveys via telephone with 719 adults in the intervention group and 753 adults in the comparison group. Results showed a 23% increase in the number of walkers in the intervention community, while there was no change in the comparison group.

Another community effort to promote walking is known as the BC Walks campaign (Reger, B., et al., 2006). This community effort was inspired by the goal of increasing the amount of moderate and intense physical activity levels and the goal of reducing chronic disease. This effort was also a quasi-experimental design that was used to see if a community-wide physical activity campaign could be used in a large community (Broome County, New York). Organizers of this campaign, similar to the previous campaign, used paid advertising, media relations, and community health activities in order to promote the activity. Impact was measured by conducting telephone surveys. Results from the campaign revealed that 78% of the survey respondents were exposed to the campaign. 16% of the participants changed from active to non-active walkers, and 47% of the respondents reported an increase in their total weekly time of walking (Reger, B., et al., 2006).

Another subtle way to increase physical activity among youth is to promote taking the stairs as opposed to elevators and escalators (Quick, M., et al., 2015). In this age, society promotes minimizing time and effort while maximizing, and although this outlook can save time, it can decrease opportunities for physical activity. The CDC recognized the value of taking stairs and created the StairWELL to Better Health Program (CDC, 2011). There are multiple challenges within this program, and many that have used this program alters it to fit the needs of their audience (i.e. work environments, schools, etc.). For example, one of the challenges is

called the Restroom Challenge, in which a person is encouraged to take the stairs to another floor whenever he/she needs to use the restroom. Three or Less Challenge is a challenge in which a person is encouraged to take the stairs if he/she is traveling three floors or less. The Calorie Challenge is based on the fact that one generally burns 10 more calories taking the stairs versus taking the elevator or escalator (CDC, 2011).

There are many community-based campaigns that can promote physical activity levels among children and adolescents. Media campaigns can serve as a successful intervention strategy since the media is a significant part of youth's daily lives. Other community efforts that can take advantage of the media include enhancing access to places for physical activity, conducting fundraisers to provide sports equipment to youth of lower socioeconomic neighborhoods, and providing outreach activities that involve representatives from local non-profit organizations and coalitions, government agencies, and church officials.

Chapter 5

Discussion and Conclusion

This Capstone project sought to examine the association between excessive screen time and obesity and in children and adolescents, as well as examine how to leverage screen time to combat obesity. The battle of childhood obesity has shown progress in recent years. According to CDC's Vital Signs report (2013), after obesity rates continued to rise for decades, states are now showing progress in decreasing childhood obesity rates, particularly among low-income preschoolers aged 2 to 4 years. Another CDC study (2014) revealed that school districts are providing healthier food options and increasing the requirements for physical activity. Childhood obesity rates have also improved at the local level (CDC, 2012). A study published in CDC's "Preventing Chronic Disease" revealed that childhood obesity has significantly declined in Philadelphia (CDC, 2012). Results from a study conducted in California suggested that childhood obesity rates decreased with a decline in sugary beverages (CDC, 2013).

Evidence from the literature review shows that sedentary behaviors in adolescents are associated with negative health outcomes. The literature revealed that excessive television (more than two hours per day) is linked to weight gain, and adolescents between the ages of 12 and 17 greatly exceed screen time recommendations. Evidence suggests that targeting parents' behavior is a promising strategy to reducing sedentary behaviors among adolescents. Parents can combat their children engaging in sedentary behaviors by encouraging them to participate in sports activities, providing a means of transportation for extracurricular activities, and participating in physical activities with their children. Socioeconomic factors such as income, physical environment, and level of education can either promote or hinder parents and adolescents from participating in physical activities.

Evidence suggests that physical activity is a key component in reducing sedentary behaviors among adolescents. Studies in the literature review revealed that physical activity has a long-term effect on chronic diseases. Increasing levels of physical activity decreases a person's chance of developing cardiovascular disease, diabetes, certain cancers, and all-cause mortality incidence. Regular physical activity can help one maintain a healthy body weight, maintain healthy bones and muscles, combat depression and anxiety, promote psychological well-being, and improve academic performance. Studies also showed a strong inverse relationship between physical activity and obesity. Vigorous physical activity, in particular, has a greater effect on obesity than low to moderate levels of physical activity. The literature also revealed that physical inactivity has negative impacts on one's health, including playing a role in insulin resistance and type 2 diabetes development.

The literature review revealed that the use of technology serves as a significant daily part of adolescent's lives. In particular, the use of mobile technologies such as tablets, handheld video game devices, and smart phones is on the rise. Active video games serves as a promising approach to reducing sedentary behaviors in adolescents. Studies showed that, over the last 15 years, the use of active video games has slowly become a means of combatting the negative effects of screen time. One study illustrated that "exergames" may have strong motivational powers on adolescents and can increase physical activity levels. Results from various studies in the literature revealed that engaging in active video games significantly increased energy expenditure. Children and adolescents are also more likely to engage in active video games than traditional exercise. Active video games that seem to be the most popular include Nintendo Wii Sports (boxing, swimming, running on the treadmill, etc.), Dance Dance Revolution, and Kinect Adventures. Studies showed that schools have begun using active video games in physical

education courses as a means to encourage students to participate. After-school sites such as recreational centers and YMCA's have also implemented the use of active video games to get students to engage in physical activity. The active video games listed above, especially Dance Dance Revolution and Wii Sport are among the most popular used in these particular settings.

There are challenges to combatting the obesity epidemic. Prevention is universally viewed as one of the best approaches to reversing disease rates, but prevention must happen at multiple levels in order to be effective. In order to combat obesity, prevention must happen at the individual, institutional, community, and government levels (Han, J. C., Lawlor, D. A., & Kimm, S. Y., 2010). Literature should be centered around research and efforts to gain a better understanding on the means of encouraging behavioral changes that will impact childhood obesity. Common sense supports the idea that decreased energy intake and increased energy expenditure will result in the prevention and/or treatment of obesity in adolescents (Ogden, C. L., Carroll, et al., 2012). Prevention efforts should therefore aim to increase levels of physical activity, decrease overall energy intake, and decrease excessive sedentary behaviors.

5.1 Limitations

There are some limitations of this capstone project. In researching statistics and studies related to sedentary behaviors in children, I did not take into consideration children with disabilities that may hinder them from participating in physical activity, such as difficulty walking, hearing, communicating, seeing, bending, or learning. In addition, I did not do an extensive amount of research on the energy intake of children and adolescents. I, instead, focused on energy expenditure and ways to increase these levels. Being that obesity is weight gain and weight gain is due to a high caloric intake, it is important to note that I only generally spoke about nutrition, and put more focus on the decreased level or lack of physical activity. The

Social Cognitive Theory is the theoretical framework used in this Capstone; however, the theory assumes that environmental changes will automatically lead to changes in an individual, and this may not always be true.

5.2 Conclusion

Childhood obesity is a major public health problem worldwide. Over 40 million children around the world are obese (WHO, 2010). Unfortunately, the number of obese children and adolescents seems to grow each decade, and one of the major contributors to this growth is sedentary behaviors (Matthews, C. E., Chen, K. Y., Freedson, P. S., Buchowski, M. S., Beech, B. M., Pate, R. R., & Troiano, R. P., 2008). The findings of this capstone project support the idea that high levels of sedentary activity and screen time are associated with weight gain and obesity in children and adolescents (Matthews, C. E., et al., 2008). In addition, it revealed that the prevalence of childhood obesity increases with higher amounts of screen time due to decreased levels of physical activity. Reducing sedentary behaviors must happen at the home, institution, and community level (Tandon, P. S., et al., 2012). Although progress has been made, the prevalence of obesity remains inadmissibly high among children and adolescents, and evidence shows that high health risks are associated with obesity. When nearly 20% of children in the United States is obese (CDC, 2016), it is essential to identify effective means of preventing obesity, and assist those already affected by obesity in maintaining a healthy weight. Preventing the onset of chronic health diseases remains an urgent public health responsibility.

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