

## ABSTRACT

### Implementing Health: A Meta-Analysis of the Effects of Implementation Intentions on Childhood Obesity Interventions

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The obesity epidemic is undoubtedly the United States' most urgent health crisis, and the underlying causes are complex and difficult to tackle. Previous studies have linked childhood obesity to both an increased risk of adulthood obesity and increased morbidity. Implementation intentions are often used in a variety of health-related interventions in adults to improve health behavior (quitting smoking, increasing productivity, reducing stress, and losing weight, just to name a few), and their effectiveness on adults has been well-documented. However, their usefulness on children is not nearly as well understood. This study attempts to analyze the effectiveness of implementation intentions on children according to the current literature, both in regards to weight-loss related behaviors and other goal intentions.

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IMPLEMENTING HEALTH: A META-ANALYSIS OF THE EFFECTS OF  
IMPLEMENTATION INTENTIONS ON CHILDHOOD OBESITY INTERVENTIONS

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## TABLE OF CONTENTS

Chapter One: An Overview of Obesity and Overweight . . . . .	1
Chapter Two: The Application of Implementation Intentions to Childhood Obesity Interventions . . . . .	16
Chapter Three: Methods . . . . .	23
Chapter Four: Meta-analysis Results and Discussion . . . . .	28
References . . . . .	34

## CHAPTER ONE

### An Overview of Obesity and Overweight

The obesity epidemic is the most urgent health problem facing the modern developed world, with a monumental quantity of deaths and billions of dollars in healthcare costs. Yet, despite its substantial impact, its complex nature makes the implementation of a large-scale solution tremendously difficult. In order to fully understand and implement a solution for the obesity epidemic plaguing the developed world, it is important first to understand obesity itself.

#### *Classification of Obesity and Overweight*

Body mass index (BMI) is the standard measurement used by health professionals to assess whether patients or populations are obese or overweight. It is calculated by dividing a person's weight by their height squared, and is expressed in terms of kilograms per meter squared. A person is considered overweight if their BMI is greater than or equal to 25 but less than 30. A BMI of 30 or greater is considered obese, and there are three subcategories, or "classes", of obesity (Class I, Class II, and Class III obesity) that indicate the degree to which a person is at risk for obesity-related morbidities (Martin, 2017).

Though BMI is a convenient way of assessing a person's body type, it does have some limitations as an overall measure of body fat. For example, a person with a greater-than-average lean muscle mass could be classified as overweight or even obese, even if he or she has relatively little body fat.

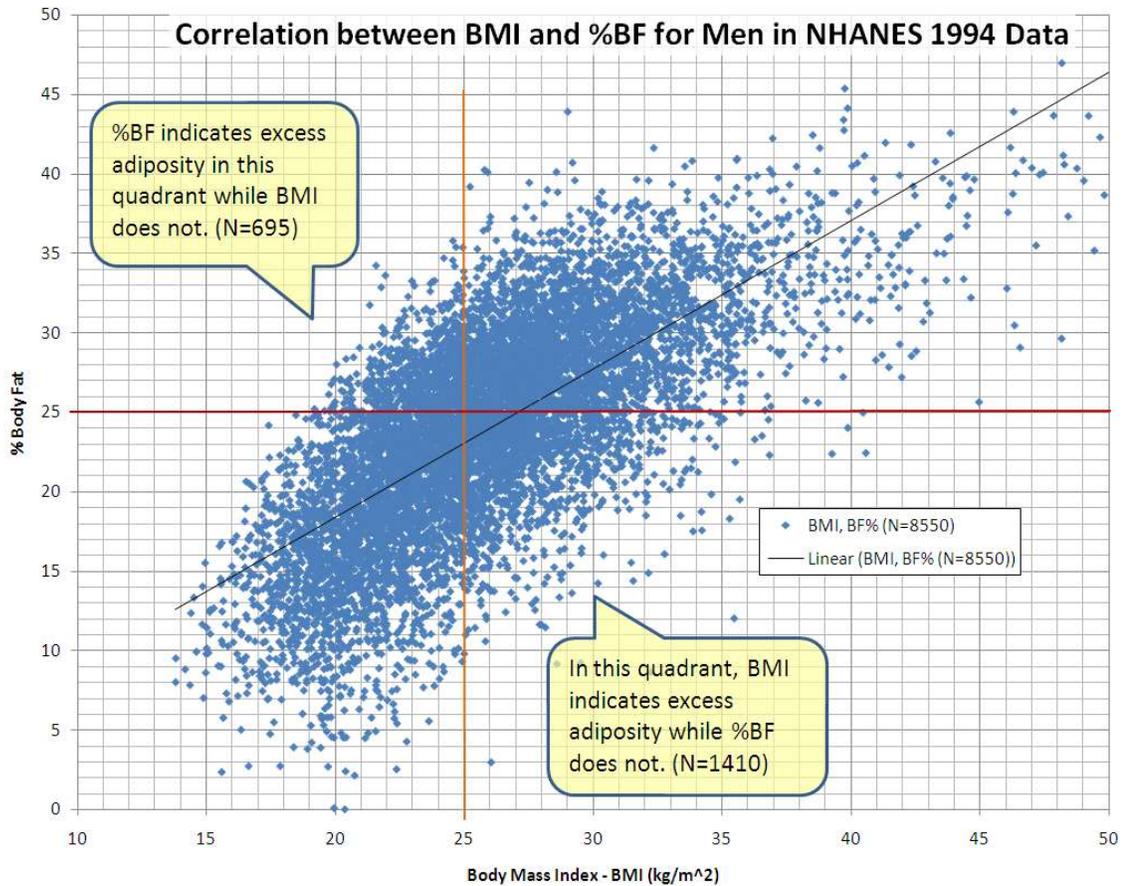


Figure 1: Correlation between BMI and percent body fat (Romero-Corral et al., 2008)

Additionally, mathematician Dr. Lloyd N. Trefethen argues, “BMI divides the weight by too large a number for short people and too small a number for tall people. So short people are misled into thinking that they are thinner than they are, and tall people are misled into thinking they are fatter” (Stephenson, 2013). Statisticians and epidemiologists have criticized the use of BMI for the diagnosis of obesity in clinical settings due to its limitations, and as such many physicians opt to use waist circumference measurements and other similar physical examinations to determine adiposity (Janssen, Katzmarzyk, & Ross, 2004).

Despite its flaws for individual assessment, body mass index remains a simple, efficient, and relatively effective tool for measuring population-level fluctuations in weight. Obesity and overweight are caused by an extensive web of factors which are constantly overlapping and interacting with one another (“Adult Obesity Causes & Consequences | Overweight & Obesity | CDC,” 2018). These factors will be discussed in the section below.

### *Biological Causes*

The biological causes of weight gain are usually quite obvious and easily verifiable. Though each person is different, and some factors may affect certain people more than others, generally speaking the biological causes of obesity and overweight are decreased energy expenditure (Paes, Marins, & Andreazzi, 2015; Booth, Roberts, & Laye, 2012) and poor diet (Murray & Bhatia, 2015; Sironi, Petz, & De Marchi, 2012). Endocrine disorders such as Cushing’s Syndrome as well as other diseases which affect metabolism can also cause obesity and overweight (Duntas & Biondi, 2013), though such cases are relatively uncommon compared to other instances of weight gain.

The human body has a series of highly evolved mechanisms for storing and using energy with maximum efficiency. Following a meal, energy-rich macronutrients such as lipids, carbohydrates, and proteins are absorbed in the gastrointestinal tract for use by the body. If the body requires energy to perform a task, then the macronutrients are hydrolyzed in order to form adenosine triphosphate, a compound which is used by cells for energy. If the energy from food consumption is not needed, it is converted by the body into glycogen via gluconeogenesis in the liver as well as triglycerides, which are stored in adipose cells located in and around the hypodermis, abdominal cavity, bone

marrow, heart, and liver. In order to store more triglycerides, the number of adipose cells in the body increases, and the individual cells themselves become larger (Fuster, Ouchi, Gokce, & Walsh, 2016).

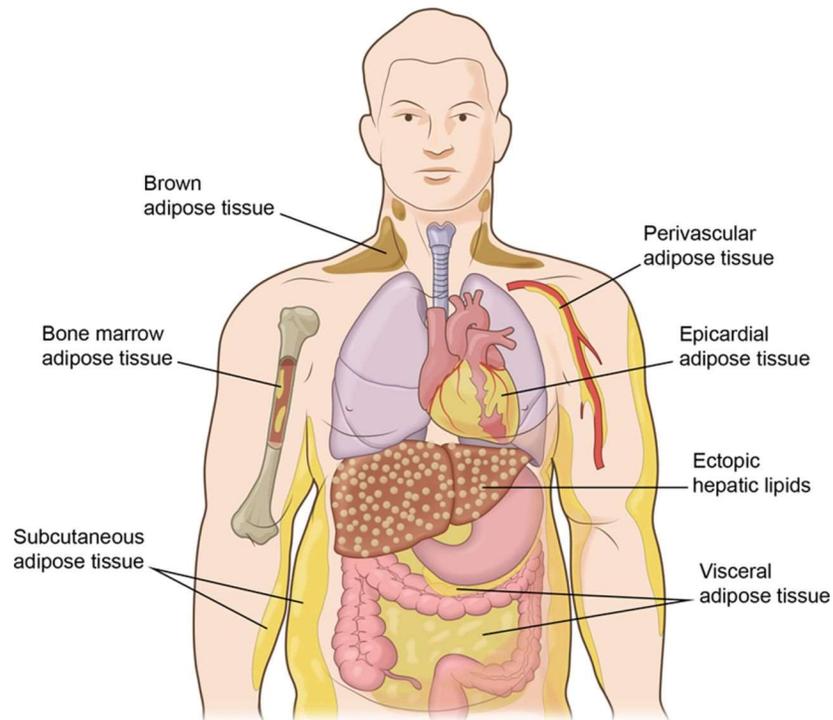


Figure 2: Adipose Tissue Depots Throughout the Body (Fuster et al., 2016)

Thus, if an individual consumes more calories than is required to perform his or her daily activities, they will likely gain weight in the form of subcutaneous and visceral fat. If an individual requires more calories to perform activities than are immediately available from food, triglycerides will be mobilized from adipose tissue to meet those energy demands, and the individual will lose weight as a result. The Department of Health and Human Services estimates that one pound of body fat is roughly equivalent to 3500 calories (“A Healthier You - Chapter 5. A Calorie Is a Calorie, or Is It?,” n.d.).

There have been a number of genes linked to an increased risk of obesity as well. At least 20 separate loci have been identified which are “involved in the regulation of

food intake through action in the central nervous system as well as in adipocyte function” (Herrera & Lindgren, 2010, p. 498). There is also an increasingly prevalent area of research which suggests that changes in the human microbiome can affect weight gain (Maruvada, Leone, Kaplan, & Chang, 2017).

### *Lifestyle Choices*

As stated previously, the caloric balance within the body is largely dictated by certain lifestyle choices, namely eating habits and physical activity (or lack thereof). Avoidance of unhealthy foods, such as processed foods, fast food, sugar, fried food, and other high-calorie food options is correlated with a healthy BMI (Schlosser, 2001). Additionally, regular consumption of fruits and vegetables is also correlated with a healthy body weight (Yasir, Ahmed, & Khan, 2017).

Adequate sleep is also important for maintaining a healthy body weight. There is a significant correlation between sleep deprivation and obesity (Patel & Hu, 2008). The reason for this is not entirely clear, but some researchers believe that abnormal sleep patterns disrupt the hormone balances of the body, which could affect metabolism or appetite, or both. Another theory is that sleep-deprived people consume more calories “simply because they are awake longer and have more opportunities to eat” (Harvard School of Public Health).

Smoking tobacco can *potentially* increase the risk of obesity because attempting to quit smoking is often correlated with weight gain. This correlation increases as packs per day increases and time since quitting decreases. Current smokers are also at an increased risk for weight gain if they smoke heavily (>20 cigarettes per day). This

association is likely correlative rather than causative, as cigarette smoking is also linked to stress and lower socioeconomic status, and subsequent attempts to quit smoking often cause withdrawal symptoms which can adversely alter eating and exercise habits (Dare, Mackay, & Pell, 2015).

### *Psychological Pre-dispositions*

A person's state of mind during everyday life has a profound effect on their eating and exercise habits. It is a common misconception that people become obese or overweight simply through sheer laziness or gluttony. In reality, a variety of feelings, emotions, and states of mind can influence a person's decision to eat too much or exercise too little in many different ways.

Depression is a major risk factor for obesity because it can significantly impair a person's ability to make good decisions concerning their health. According to the American Psychological Association:

Many people who have difficulty recovering from sudden or emotionally draining events (e.g., loss of a close friend or family member, relationship difficulties, losing a job or facing a serious medical problem) unknowingly begin eating too much of the wrong foods or forgoing exercise. Before long, these become habits and difficult to change. (Weiss, Molitor, & Sheet, n.d.)

Depression is especially detrimental to a person's health because in addition to causing obesity and overweight, it is also caused *by* obesity and overweight. The negative perception of one's body brought about by obesity and overweight can initiate or exacerbate depression, leading to an endless cycle of poor physical and psychological health.

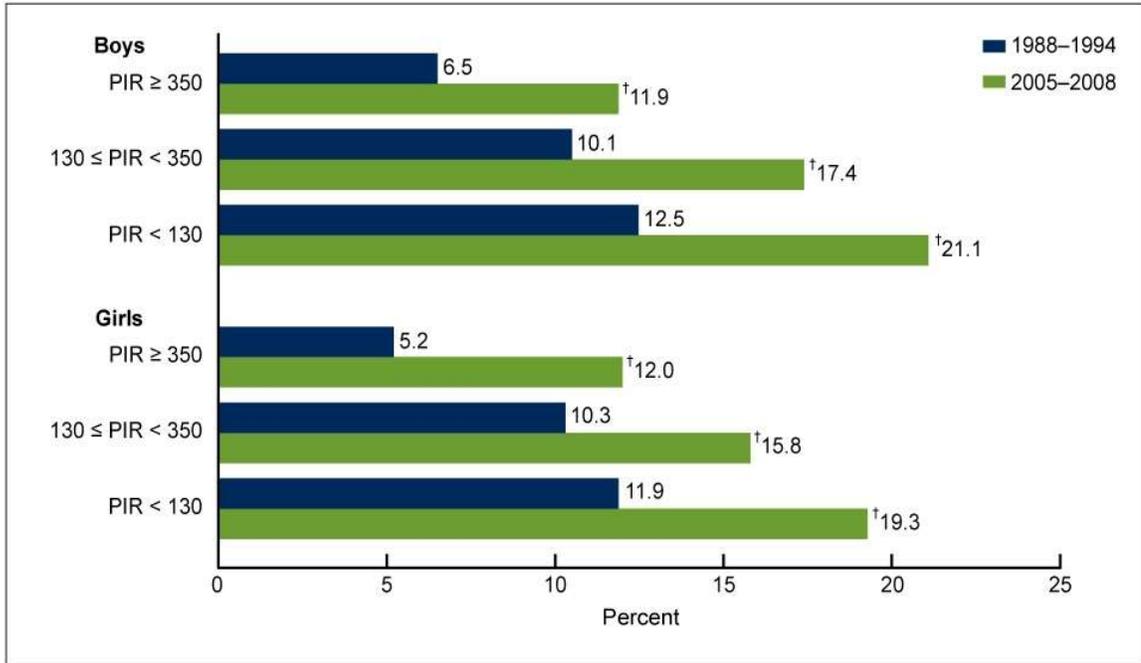
Chronic stress is another psychological risk factor for obesity. In response to stress, the hypothalamus releases corticotropin-releasing hormone (CRH), which stimulates the secretion of adrenocorticotropic hormone (ACTH) by the anterior pituitary gland, which in turn stimulates the secretion of cortisol by the adrenal glands. Long-term cortisol exposure has been shown in some studies to be linked to overeating and obesity (Bose, Oliván, & Laferrère, 2009). Stress can be caused by social, economic, or even genetic factors, just to name a few.

### *Sociological Trends*

Social factors such as socioeconomic status, race, and sex have broad influences on health in some form or fashion, and obesity is a perfect example of a disease that disproportionately affects certain groups of people.

### *Socioeconomic Status*

In much of the developed world, people of lower socioeconomic status are more likely to be obese. This could be due to a heavier reliance on fast food (and other food options which are less expensive but more unhealthy), less reliable access to weight loss resources, more stress, less sleep, a weaker social support network, or some combination of the aforementioned factors (Pampel, Denney, & Krueger, 2012).



†Significant increase.

NOTE: PIR is poverty income ratio.

SOURCES: CDC/NCHS, National Health and Nutrition Examination Survey, 1988–1994 and 2005–2008.

Figure 3: Obesity among Adolescents by PIR of Parents (Ogden et al., n.d.)

In the developing world, the opposite appears to be true: people of higher socioeconomic status tend to be more obese in lower-income countries. In countries such as Zimbabwe and Somalia, the extreme poverty of the lower class causes severe malnourishment, which drastically reduces BMI. This raises the interesting question of whether obesity is a disease of the rich or a disease of the poor; the consequences of food insecurity for the individual depend largely upon the overall affluence of the society as a whole:

Consider first the monetary costs of excess food in poor countries. Food shortages in these countries make excess weight relatively uncommon, particularly for low SES groups. Whereas food insecurity in affluent nations often means lack of access to healthy food, it relates for many in poor countries to the lack of access to any food. Groups without physical access to food, the monetary resources to purchase food, and the social power to demand a share of available food suffer from undernourishment rather than obesity. The nature of

food insecurity in poor countries should in turn affect the relationship between SES and body weight. Low SES limits the resources available for excess food consumption and increases physically demanding labor, whereas high SES increases both access to excess food and avoidance of physically demanding work. These conditions limit weight gain among low SES groups and encourage weight gain among the affluent in developing countries. (Pampel et al., 2012)

The trend of obesity among the economically privileged is also apparent in the pre-industrial Western world. Before the advent of widely available processed food, obesity was a status symbol of the wealthy because it displayed a lifestyle of leisure and luxury (which is strikingly similar to the situation in modern developing countries). Thus, the appearance of the obese lower class in Western society is a relatively recent phenomenon (Bray, 1990).

#### *Sex and Gender*

Men are more likely to be overweight than women, but women are more likely to be obese than men. According to the National Health and Nutrition Examination Survey, a continuously ongoing series of cross-sectional studies done by the National Center for Health Statistics, 68.8% of men and 61.6% of women under age 20 have a BMI of 25 or greater, while 27.6% of men and 33.2% of women in the same age group have a BMI over 30. This phenomenon occurs across all other age groups as well, and the gap between obesity in men and women is even wider among racial minorities (Wang & Beydoun, 2007).

#### *Race*

In the United States, obesity rates vary quite substantially by race. Approximately 72.0% of African Americans, 70.5% of Native Americans, 69.9% of Hispanics and

Latinos, 64.1% of Caucasians, and 42.0% of Asians/Pacific Islanders are overweight or obese. This is partially due to cultural variances between races:

Culture is believed to contribute to disparities in childhood obesity in numerous ways. First, body image development occurs in a cultural context, and ethnic/cultural groups differ in their shared understandings as to valued and disvalued body image. For instance, perceived ideal body size for African American women is significantly larger than it is for white women, and African American men are more likely than non-Hispanic white men to express a preference for larger body size in women. The mean BMI at which white women typically express body dissatisfaction is significantly lower than that for African American women. Given that women typically assume primary responsibility for the care, feeding, and education of children, including the transmission of shared cultural understandings, the beliefs that women possess with respect to their own body image have implications for their perception of and response to the body image of their children. This pattern may vary by ethnicity. For instance, non-Hispanic white mothers' dietary restraint or their perceptions of their daughters' risk of overweight can influence their young daughters' weight and dieting behaviors. In contrast, Latinas tend to prefer a thin figure for themselves but a plumper figure for their children. (Caprio et al., 2008)

Additionally, as stated previously, low socioeconomic status is associated with increased risk of overweight and obesity, and racial minorities in the United States are disproportionately impoverished when compared to Caucasian Americans. This socioeconomic vulnerability among African American and Latinos could also lead to obesity.

### *Health Complications*

Obesity has been empirically connected to a substantial number of diseases, dysfunctions, and disabilities that severely limit the longevity and quality of life. Approximately 1 in 5 deaths in the United States is attributable to obesity (Olson, 2016). Moderate obesity can reduce average life expectancy by 3 years, and severe obesity can reduce life expectancy by up to 10 years (Masters et al., 2013).

Obese and overweight is strongly associated with elevated arterial blood pressure. “Obese individuals have an increase in fatty tissue that increases their vascular resistance and in turn increases the work the heart has to do to pump blood throughout the body” (Delaney, n.d.). Hypertension in and of itself is not necessarily symptomatic, but it along with several other comorbidities associated with obesity such as elevated low-density lipoprotein levels, reduced high-density lipoprotein levels, and impaired blood glucose metabolism can lead to a wide variety of cardiovascular disease (Eckel, 1997). Some long-term studies even suggest a direct causal/predictive relationship between obesity and certain forms of cardiovascular disease, such as coronary atherosclerosis and ischemia (Rabkin, Mathewson, & Hsu, 1977).

Heart disease is the single leading cause of death in the United States, and excess adiposity either directly causes or indirectly exacerbates almost all known forms of heart disease. Middle-aged overweight women have a 50% increased risk of coronary heart disease compared to non-overweight women (Manson et al., 1995), and middle-aged overweight men have a 72% increased risk (Eckel, 1997). The systemic hypertension caused by obesity (which causes the heart muscles to work harder) often leads to left ventricular hypertrophy, the precursor for congestive heart failure. Hypertension and atherosclerosis, both of which are exacerbated by obesity, are significant risk factors for having a stroke. For each unit increase of BMI, the relative risk of having a stroke increases by 6% (Kurth et al., 2002).

Diabetes mellitus is a group of diseases characterized by elevated blood glucose levels caused by a dysfunction in insulin metabolism. It is the 7<sup>th</sup> leading cause of death in the United States, with over 250,000 deaths annually. There are over 30 million

known cases of diabetes in the U.S. currently and 1.5 million new cases every year (American Diabetes Association, n.d.). There are two main subgroups of diabetes: type 1 and type 2. The former is primarily an autoimmune disorder in which the immune system attacks the insulin-producing cells in the pancreas. The latter is caused by the body's inability to respond normally to insulin, which is generally referred to as insulin resistance. Obesity is a major risk factor for developing insulin resistance; approximately 90% of type 2 diabetes patients suffer from obesity or overweight (The Obesity Society, n.d.).

According to the American Cancer Society, being obese or overweight is linked to certain types of cancers (“Does body weight affect cancer risk?,” n.d.). There is a clear relationship between body mass index and incidence of breast cancer (after menopause), gastrointestinal cancer, endometrial cancer, renal cancer, and pancreatic cancer. There are also several other types of cancers for which obesity could possibly be a risk factor, though a clear relationship has not been established. These include gallbladder cancer, hepatic cancer, non-Hodgkin lymphoma, multiple myeloma, cervical cancer, ovarian cancer, and prostate cancer. The obesity-cancer relationship is still an area of ongoing research; many recent studies have suggested that obesity causes cancer by suppressing the immune system and creating hormone imbalances, though the exact causation varies with each type of cancer. For example, obese people generally have higher estrogen levels, which can directly cause breast cancer after menopause (Basen-Engquist & Chang, 2011).

### *Economic Costs*

Obesity and overweight are extremely burdensome to the United States' already overburdened healthcare system. Annual healthcare costs for obesity-related illnesses and diseases are estimated to be at least \$147 billion and might even be as high as \$210 billion (Cawley & Meyerhoefer, 2010). Moreover, obesity and overweight also negatively impact the economy in a number of other ways in addition to the direct healthcare costs of treating obese and overweight patients. Obesity-related job absenteeism costs employers \$4.3 billion annually (Cawley, Rizzo, & Haas, 2007). Even while present at work, moderately and extremely obese workers cost their employers, on average, \$506 per person per year in lost productivity due to extra time needed to perform physically demanding tasks (Gates, Succop, Brehm, Gillespie, & Sommers, 2008). In 2000, obese and overweight airplane passengers cost airline companies approximately \$275 million in fuel (Dannenberg, Burton, & Jackson, 2004).

### *Childhood Obesity*

Obesity is a disease that affects people of all age groups, including children. The Centers for Disease Control and Prevention estimates that around 12.7 million adolescents suffer from obesity, a prevalence rate of roughly 17%. This rate has more than tripled in value in the past four decades. There is even a somewhat significant presence of obesity among toddlers: approximately 8.9% of children 2 to 5 years old are obese (“Childhood Obesity Facts | Overweight & Obesity | CDC,” n.d.).

Childhood obesity is in many ways a more severe disease than adulthood obesity. In addition to many of the health problems that adults with obesity face (cardiovascular

disease, diabetes, joint problems, etc.), the early onset of these problems often worsens their severity due to their progressively degenerative natures. Children with obesity are also often subjected to social ostracization and discrimination to a much greater degree than adults with obesity, which can lead to severe psychosocial dysfunction which can persist into adulthood. As a result, obese children as well as adults who were once obese children are far more likely to suffer from low self-esteem and depression (“Health Risks of Childhood Obesity - Bariatric and Metabolic Institute | UC San Diego Health,” n.d.).

## Complications of Childhood Obesity

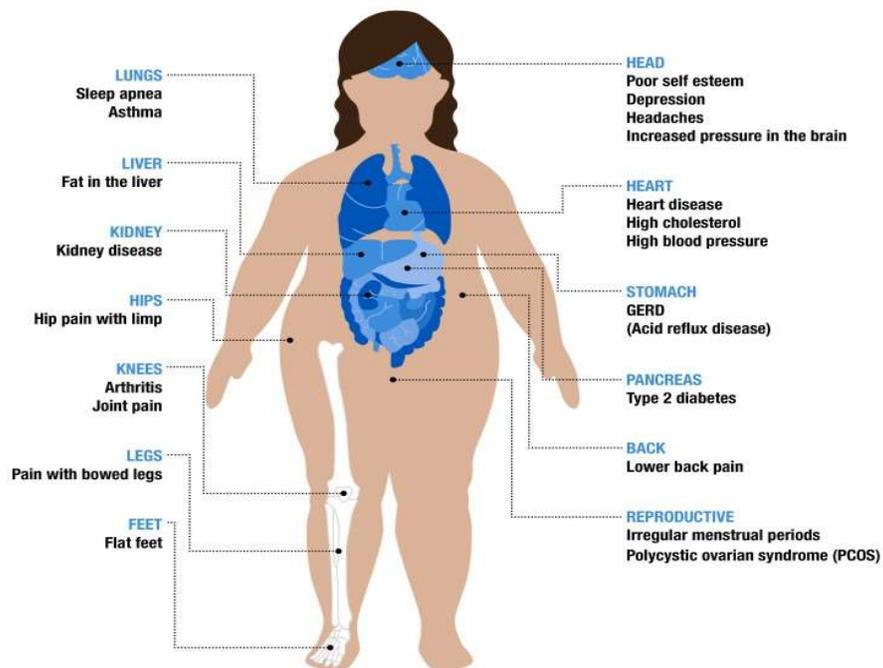


Figure 4: Complications of Childhood Obesity (Michalsky, 2015)

Finally, obese children are far more likely to become obese adults than children with normal body mass indexes. About one-third of obese toddlers and one-half of obese children and adolescents become obese adults. These risks are over double those of non-obese children of the same age groups (Serdula et al., 1993). This could be due to the psychosocial dysfunctionality caused by childhood obesity manifesting into adulthood depression and stress (which, as discussed previously, is a major risk factor for obesity), the habituation of poor health habits into adulthood, or even possibly genetic factors (Biro & Wien, 2010).

## CHAPTER TWO

### The Application of Implementation Intentions to Childhood Obesity Interventions

The obesity epidemic in the developed world must be fought on two fronts: the individual and the public. In the public health sphere, huge nationwide campaigns are underway to educate the masses about the health risks of obesity and the ways to prevent it (Walls, Peeters, Proietto, & McNeil, 2011). On the individual level, obesity interventions can be performed by physicians, nutritionists, fitness trainers, and psychiatrists depending on the individual patient's circumstances and needs. It is especially important to intervene in the cases of childhood obesity because obesity during childhood can cause significantly more morbid health outcomes later in life, and successful intervention against obesity at a young age is predictive of maintaining a healthy body weight throughout adulthood (Spear et al., 2007) (Hampl, Paves, Laubscher, & Eneli, 2011).

Success or failure of treatment of obesity depends largely upon the patient's willingness to adhere to the advice of their physician and continue exercising and dieting. It is often incumbent upon the person administering treatment to provide motivation and support for the patient, both directly and by establishing a strong social support network with friends and family (Keller et al., 2014). This establishment of external motivation drastically improves treatment outcome for all types of treatment. For a healthcare provider treating an obese patient, a thorough understanding of the different tools used to motivate, support, and encourage their patient is critical to a successful outcome.

### *The Importance of Childhood Obesity Interventions*

While many interventions are undertaken preemptively, interventions for obese and overweight patients are often performed during adulthood and long after major health complications have already begun. The post-intervention health prognosis largely depends on the degree of pre-intervention obesity as well as the severity of pre-intervention morbidity. Many diseases caused by obesity, such as atherosclerosis and cancer, persist even after the obesity has been successfully treated. Thus, the administration of effective treatment as early as possible is key to producing good health outcomes. Of course, not all obese adults were once obese children, but in the case of obese children, it is important to seek treatment prior to the onset of health complications.

In addition, as stated previously, obese children are much more likely to become obese adults. That being the case, successful treatment of childhood obesity is a highly cost-effective method for controlling the adult obesity rate at a population level, especially with the use of implementation intentions and other similar methods that are effective at creating lifelong good health habits. Targeting childhood obesity is also cost-effective since childhood obesity interventions are much more likely to be successful than adult obesity interventions; in a study of 113 families undergoing family-based behavioral interventions, “[the] children were more likely than their parents at each time point to have percent overweight decreases greater than 20%, with over 20% of the children and less than 1% of the parents showing changes this large” (Epstein, Valoski, Kalarchian, & McCurley, 1995).

### *Implementation Intentions and their Benefits*

Implementation intentions are defined as “if-then plans that spell out in advance how one wants to strive for a set goal. For the if-component, a critical cue is selected (e.g., a good opportunity, an anticipated obstacle) that is linked to a goal-directed response in the then-component” (Gollwitzer & Oettingen, 2013). When setting goals for oneself, it is often quite easy to be strongly committed and motivated at first. However, during the course of goal-striving, commitment and motivation usually taper off, especially if reaching the goal requires rigorous work and dedication. This is why simply having a goal intention (the intention of completing a goal) is usually not sufficient to achieve said goal. In fact, a goal intention by itself accounts for only a 28% greater likelihood of completing a goal (Sheeran, 2002).

Goal intentions can be supplemented by the use of implementation intentions, which provide a roadmap for handling the possible situations that can arise while striving for a goal. The specificity of implementation intentions (as opposed to the generality of goal intentions) is often the most helpful aspect of their usage. For example, a patient might have a goal of losing 20 pounds in a certain amount of time. With only that goal intention, it might be quite difficult to continue working toward that goal for a prolonged timeframe, especially if the patient encounters physical and/or psychological obstacles on the way. The patient could be more specific with their goal intention, such as having the goal of limiting themselves to 2000 calories per day, and exercising three times a week. Even this, however, can present as quite the challenge. In this situation, the patient could apply several implementation intentions, such as, “If I go with my friends to a restaurant, then I will order a salad,” or “If I get the day off work, then I will jog around the block.”

The patient could even create implementation intentions that anticipate and correct for possible missteps in their goal-directed behavior, such as, “If I eat more than 2000 calories in a day, then I will exercise an extra day,” or “If I miss an exercise day, then I will only eat 1500 calories that day.” These specific action plans make working towards a goal much easier. “Goal intentions merely specify a desired future behavior or outcome. On the contrary, the if-component of an implementation intention specifies when and where one wants to act on this goal, and the then-component of the implementation intention specifies how this will be done” (Gollwitzer & Oettingen, 2013).

The effectiveness of the usage of implementation intentions in order to continue striving to complete a goal is quite significant. Implementation intentions have been shown to significantly increase the likelihood of a person starting goal-oriented behavior as well as staying on track with their behavior over a period of time. Because the critical scenario in an implementation intention (the “if-component”) is a highly specific anticipated event, it becomes an easily accessible mental cue. The increased accessibility of this cue makes it much easier to act upon with a specific planned behavior (the “then-component”) because it is both more specific and more tangible than a simple goal intention.

In addition to helping with starting and staying on track with goal-oriented behaviors, implementation intentions have been proven effective with helping to avoid unwanted or potentially harmful behaviors. Implementation intentions can be specifically created for situations in which the opportunity to perform an unwanted behavior is presented. It is generally much easier to avoid such behaviors if the patient

has a detailed plan of action for doing so. This is especially useful for patients who are attempting to overcome obesity by losing weight since avoidance of unhealthy foods and a sedentary lifestyle is key to success. “Staying on track may then become very difficult when certain internal stimuli (e.g., being tired, stressed out) or external stimuli (e.g., temptations, distractions) interfere with the desired goal pursuit. Implementation intentions can be used to protect started goal strivings from interferences stemming from both inside and outside the person” (Gollwitzer & Oettingen, 2013).

### *Limitations of Implementation Intentions*

Of course, the practical applications of implementation intentions do have their limitations. The most obvious example of these limitations is the fact that even with implementation intentions, striving toward a goal which requires stringent dedication and a considerable amount of willpower is quite difficult. A weaker-willed person might find that he or she is unable or unwilling to stick to the pre-prescribed plans of action, or that he or she is only able and willing to do so for a limited time span.

It has also been observed that social perfectionists (those that strive to perfectly conform to social expectations) tend to not respond as strongly to implementation intentions. This is due to the fact that they often feel that societal expectations fluctuate far too frequently. The specific action plans outlined in implementation intentions make it difficult for these individuals to respond to novel social situations effectively (Gollwitzer & Oettingen, 2013).

Finally, implementation intentions tend to be less effective if the goal intention is to overcome a strong, harmful habit (such as smoking or habitual drinking). Though

implementation intentions can greatly enhance one's ability to stick to a plan of action, a harmful habit which is too addictive or tempting could derail one's intentions of overcoming it. Implementation intentions work because they magnify the retrievability of certain cues, not because they directly increase a person's willpower or lessen the magnitude of challenges one must overcome to achieve a goal (though they could indirectly have these effects).

### *Applications of Implementation Intentions for Weight Loss Therapy*

The goal intention of losing weight is one that benefits quite significantly from the usage of implementation intentions because it requires constant, dedicated adherence to goal-directed behavior. For weight loss, these goal-directed behaviors include exercising regularly (which can be both physically and psychologically resource-intensive) and eating healthy (which requires both the regular consumption of healthy foods *and* the avoidance of excess unhealthy foods). Each individual's situation is different; for example, the behavior of exercising regularly might be difficult for an individual who works long hours or has other responsibilities, and the behavior of eating healthy might be difficult for an individual who has dietary restrictions. In these cases, implementation intentions can still be used if they are specifically tailored to handle these special circumstances. There are other goal-directed behaviors for weight loss that benefit from implementation intentions as well, such as getting adequate sleep and controlling stress.

The current gold standard for weight loss intervention utilizes the Health Action Process Approach (HAPA); (Hattar, Hagger, & Pal, 2015), which acknowledges the formation of goal intentions by the patient (the motivation phase) and actually performing

goal-directed behaviors (the volitional phase), and underscores the “perceived self-efficacy at different stages of health behavior change” (Conner & Norman, 2005). When used to supplement this type of intervention, implementation intentions have been shown to increase a patient’s physical activity level by as much as 23.7% (Bélanger-Gravel, Godin, Bilodeau, & Poirier, 2013) and significantly increase fruit and vegetable consumption (Adriaanse, Vinkers, De Ridder, Hox, & De Wit, 2011).

## CHAPTER THREE

### Methods

The current literature contains relatively few studies that are able to directly correlate the usage of implementation intentions with weight loss in overweight and obese children. The primary focus of studies on implementation intentions is usually their usefulness in breaking unhealthy habits, but most often the participants are adults rather than children. While this is somewhat useful for providing valuable insight into the overall effectiveness of implementation intentions, it is severely insufficient as evidence for the effectiveness of implementation intentions on children, especially since some studies have suggested that children respond differently to implementation intentions when compared to their adult counterparts (Meyer, 2015). In light of this, a meta-analysis of the current literature on the effectiveness of implementation intentions in children is useful. Since literary resources are somewhat limited, the scope of the analysis will be broadened to include all studies which examine the effects of implementation intentions on children, not just those which analyze specifically weight loss.

#### *Search Methods*

Using Academic Search Complete, articles were searched for using the keywords “children” and “implementation intentions”. The search retrieved articles which contained *both* of these keywords. The results of this search were narrowed to only journal articles from scholarly, peer-reviewed journals. The results were limited further to only articles written in English.

After all these criteria were applied to the search, a total of 34 articles remained. These remaining articles were then manually reviewed for relevance to the meta-analysis. Ten studies were eliminated because they did not utilize implementation intentions, three studies were eliminated because their participants were not children, and twelve studies were eliminated because they examined neither children nor implementation intentions. Despite the English language filter, one non-English article remained; this article was eliminated. Finally, one article was eliminated because it was identical to an article which had already been included. After this relevance check, seven articles remained.

### *Relevant Articles*

One article appearing in the search was “Mental contrasting with implementation intentions enhances self-regulation of goal pursuit in schoolchildren at risk for ADHD” (Gawrilow, Morgenroth, Schultz, Oettingen, & Gollwitzer, 2013). The study in this article examines the usage of implementation intentions on children with ADHD. Though this article was not related to obesity, weight loss, or the behaviors directly associated with either, it does involve self-regulation, a category of behaviors which encompasses many of the more specific behaviors directly correlated with weight loss. Because of this, the article was deemed relevant to the meta-analysis. Possible considerations and qualifications include the possibility that children with ADHD respond overall differently to implementation therapy than children without ADHD, and the possibility that the behaviors observed in the study have no practical correlation to behaviors associated with weight loss.

There were two other articles in the search which involved children with ADHD, which had both similar aims and methods to the aforementioned study. These two

articles were “Implementation Intentions Facilitate Response Inhibition in Children with ADHD” (Gawrilow & Gollwitzer, 2008) and “If-Then Plans Benefit Delay of Gratification Performance in Children With and Without ADHD” (Gawrilow, Gollwitzer, & Oettingen, 2011). They were deemed relevant for similar reasons to the first article, and the considerations are identical.

An article in the search, “The Roles of Behavioral and Implementation Intentions in Changing Physical Activity in Young Children With Low Socioeconomic Status” (Armitage & Sprigg, 2010), is extremely relevant to the meta-analysis as it examines the relationship between implementation intentions and physical activity, a behavior directly associated with weight loss. Specifically, the study focuses on children with low socioeconomic status. This could be both a beneficial and detrimental focus for the purposes of this analysis; as mentioned in previous chapters, lower socioeconomic status is correlated with higher obesity rates, but unfortunately because of the narrower focus the results are less generalizable.

Another article in the search, “Creating action plans in a serious video game increases and maintains child fruit-vegetable intake: a randomized controlled trial” (Thompson et al., 2015), was also deemed relevant to the analysis for similar reasons to the previous article: it examined the link between implementation intentions and a weight-loss behavior in children. Additionally, while the previous study focused on physical activity, this study focuses on fruit and vegetable intake, which greatly diversifies the scope of the results. However, rather than using direct implementation intention therapy, the study used a video game with built-in implementation suggestions.

Thus, it is worth noting that the approach used differs from traditional implementation intention therapy.

The next article in the search, “Understanding adolescent smoking: the role of the Theory of Planned Behaviour and implementation intentions” (Higgins & Conner, 2003), is difficult to place in terms of relevancy with respect to the other articles. On one hand, it does examine the role of implementation intentions in resisting negative health behavior in children, and that behavior is smoking, which is directly correlated with obesity. On the other, smoking is less directly related to obesity compared to physical activity and healthy eating, but regardless of the negative behavior examined in the study and regardless of that negative behavior’s relationship to obesity, the article still provides valuable insight for the purposes of the analysis. Interestingly, the study not only focuses on implementation intentions; it compares their effectiveness to that of the Theory of Planned Behavior, a psychological concept which “creates a link between one’s beliefs and one’s actions” (Ajzen, 1991).

The next article in the search, “Promoting children's fruit and vegetable consumption: Interventions using the Theory of Planned Behaviour as a framework” (Gratton, Povey, & Clark-Carter, 2007), also compares an intervention based on implementation intentions with an intervention based on the Theory of Planned Behavior. Like the Thompson article, it also aims to increase fruit and vegetable consumption, making it very relevant to the analysis.

Since the majority of the articles in the search which directly relate to both implementation intentions and childhood obesity involve increasing fruit and vegetable consumption, this particular behavior will be the focal point of the discussion. Using

implementation intentions to increase the frequency of outdoor activities and other forms of exercise is equally important, but unfortunately the existence of only one such article will make the discussion of this somewhat limited in terms of meaningfulness.

### *Meta-Analysis Methods*

The meta-analytical portion of the literature review will undoubtedly provide valuable empirical insight into the hypothesis that obese children can be effectively treated using implementation intentions. The analysis will be used to amalgamate the results of many studies in current literature. It will include all of the aforementioned relevant articles despite their varying degrees of relevancy and scope. The studies will be divided into two groups: those which do not examine the effects of implementation intentions on weight loss behaviors, and those which do. The studies which do examine weight loss behaviors will be further divided into studies which examine fruit and vegetable consumption and studies which examine physical activity. The effect sizes will be analyzed to determine whether there are differences in effects between implementation intentions that target weight-related behaviors and those that target non-weight-related behaviors.

The software used to calculate overall effect size and other important statistical values will be SPSS Statistics. It is a software package developed by IBM and used worldwide for statistical analysis. The summary statistics (mean, median, standard deviation), sample sizes, effect values, and other relevant variables will be inputted into this software.

## CHAPTER FOUR

### Meta-Analysis Results and Discussion

#### *Pre-analytical Statistics*

The meta-analysis was run using IBM SPSS Statistics 25, with meta-analysis macros created by Dr. David Wilson at George Mason University. First, the effect size for each study was calculated using mean differences between the control and experimental groups as well as pooled standard deviation. Next, weight was assigned to each study according to internal variance.

Article	N <sub>e</sub>	N <sub>c</sub>	Mean <sub>e</sub>	Mean <sub>c</sub>	s	Variance	ES	Weight
Gawrilow 1	60	56	5.87	5.53	2.12483	4.514904	0.160013	0.221489
Gawrilow 2	29	29	89.9	78.26	7.97584	63.61405	1.459407	0.01572
Gawrilow 3	24	23	4.57	3.55	1.88000	3.534433	0.542551	0.282931
Higgins	28	30	0.68*	0.64*	0.91565	0.83843	0.043684	1.192705
Armitage	39	38	4.66	4.1	0.76300	0.582173	0.733942	1.717701
Thompson	387	387	2.07	1.84	0.59016	0.6192	0.864159	1.614987
Gratton	103	43	2.77	1.91	1.21622	1.4792	0.707107	0.676041

Table 1: Macro Input by Article

Finally, this information was inputted into the SPSS program and the macros were run.

#### *Overall Results*

The overall weighted mean effect size across all seven studies was medium-to-large. Results were the same between fixed and random effects models.

Model	Mean ES	-95%CI	+95%CI	SE	Z	P
Fixed	0.5939	-0.2255	1.4132	0.4180	1.4205	0.1554
Random	0.5939	-0.2255	1.4132	0.4180	1.4205	0.1554

Table 2: Overall Results using Fixed and Random Effects Model

The results indicate that implementation intentions are effective (but not uniformly effective) as a method for intervention for all types of behavior studied in the seven articles included in the analysis. To further analyze the effectiveness of implementation intentions on specific behaviors, the studies were divided into groups according to the behavior on which they focused.

*Weight Loss vs. Non-Weight Loss Associated Behaviors*

The studies were first divided into two groups: studies which analyzed interventions to promote weight loss associated behaviors (WLAB) and those that analyzed behaviors other than weight loss associated behaviors, henceforth referred to as non-weight loss associated behaviors (NWLAB). These two groups were then analyzed separately and compared. The results are shown in the table below:

Behavior	Mean ES	-95%CI	+95%CI	SE	Z	P
NWLAB	0.1534	-1.3451	1.6518	0.7645	0.2006	0.8410
WLAB	0.7818	-0.1969	1.7604	0.4993	1.5657	0.1174

Table 3: Results by Behavior Group

The effects of implementation intentions on WLABs, NWLABs, and their overall effects are summarized in the figure below:

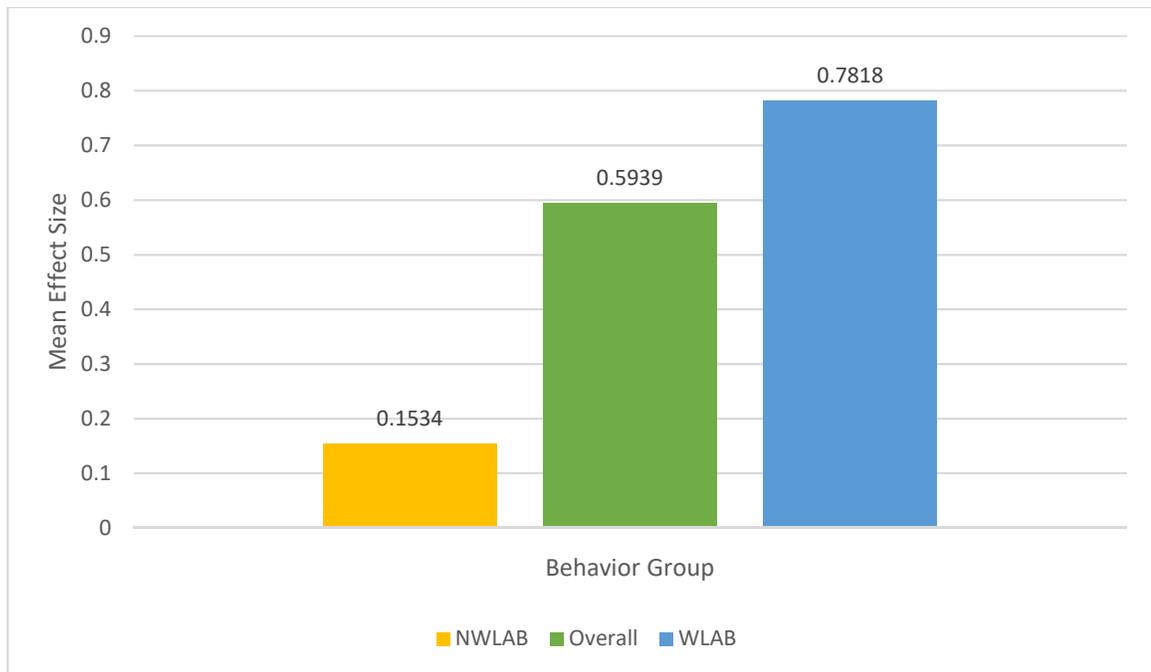


Figure 1: Mean Effect Size by Behavior Group

The effect size for WLABs was medium-to-large, while the effect size for NWLABs was small. The results of WLAB studies contributed to a much greater degree to the overall effect size due to having an overall larger weight.

#### *Analysis of Behavior Subgroups*

The study groups were then further divided into subgroups which corresponded more specifically to the behaviors analyzed in each of them. Studies in the NWLAB group were divided into studies which focused on managing ADHD symptoms and those which focused on preventing smoking. Studies in the WLAB group were divided into studies which focused on increasing physical activities and those which focused on increasing fruit and vegetable (FV) consumption. The results of this subgroup analysis are summarized in the figures below:

Behavior	Mean ES	-95%CI	+95%CI	SE	Z	P
ADHD	0.4059	-2.3174	3.1292	1.3894	0.2921	0.7702
Smoking	0.0437	-1.7508	1.8382	0.9155	0.0477	0.9619
Phys. Act.	0.7339	-0.7605	2.2284	0.7625	0.9626	0.3358
FV	0.8177	-0.4773	2.1126	0.6607	1.2376	0.2159

Table 4: Results by Behavior Subgroup

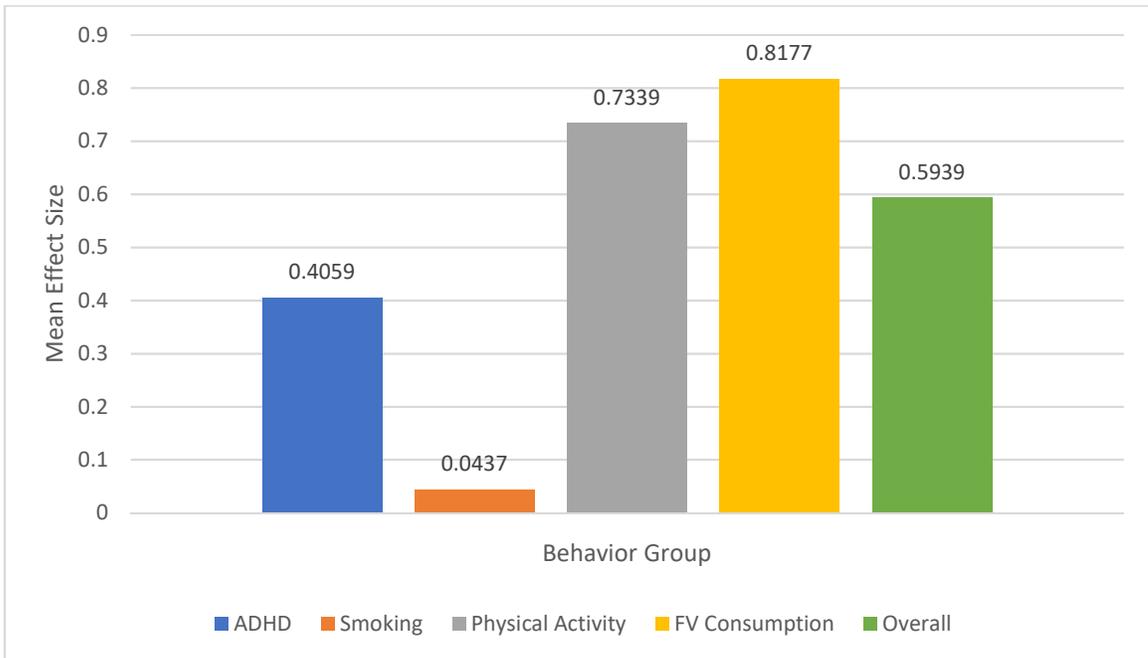


Figure 2: Mean Effect Size by Behavior Subgroup

### *Discussion*

The results indicate that implementation intentions generally have a robust effect on youth when targeting weight-related behaviors. Results for both subgroups of weight loss related behaviors showed at least medium-to-large effect sizes, and surprisingly both of these behavior subgroups have more positive results than the non-weight loss behavior

subgroups. The results for this analysis for the WLAB group are comparable to previous studies on implementation intentions with adults, which have found large effect sizes (Hattar et al., 2015).

These results have strong implications for the future of interventions to treat childhood obesity patients. The results indicate that implementation intentions may be useful as a preventative measure for childhood obesity as well. For example, *Squire's Quest! II: Saving the Kingdom of Fivealot* (the online video game used by Thompson et al. in their study on FV consumption) is an extremely cost-effective way to increase fruit and vegetable consumption in both obese and non-obese children. Preventing childhood obesity rather than simply treating it when it occurs can greatly help avert future morbidity and mortality.

#### *Limitations*

The most obvious limitation of this study is the sparse number of articles used in the study, especially with regards to weight loss associated behaviors. This limited amount of literature became even more apparent during the subgroup analysis, when only one article was available for both the smoking and physical activity subgroups. Another limitation is the lack of consistency in the objectives of the studies.

Clearly, more research needs to be done on the topic of using implementation intentions in childhood obesity interventions and with health-related behaviors on children in general. With the ever-present childhood obesity epidemic causing unprecedented morbidity in the United States and the rest of the western world, it is quite alarming that such a small body of research is present on the subject, especially

considering the much larger pool of evidence of the effectiveness of implementation intentions on adults. The results of this analysis are quite promising, but there is undoubtedly more work to be done.

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