# BMI, CARDIOVASCULAR FITNESS, AND HEALTH-RELATED FITNESS KNOWLEDGE IN ADOLESCENTS

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A Thesis

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by

Rebecca Luanne Avilla

Spring 2014

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DEDICATION

*I dedicate my thesis to Annie & Lena,*

*for always providing a welcoming distraction.*

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# ABSTRACT

BMI, CARDIOVASCULAR FITNESS, AND HEALTH-RELATED

FITNESS KNOWLEDGE IN ADOLESCENTS

by

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Master of Arts in Kinesiology

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The purpose of this study was to examine the relationship between body mass index (BMI), cardiovascular fitness, and health-related fitness knowledge in Jr. High School aged students. The study included 60 $7^{th}$ grade students (30 males and 30 females) from a rural, low-income school in the valley of Northern California. Four methods of data collection were used in this study. Height and weight were collected to calculate BMI, a 15-meter PACER was incorporated to determine cardiovascular fitness, a validated, 20 question assessment, was used to measure health-related fitness knowledge and birthdays, gender, and ethnicity were retrieved from the school. Descriptive statistics were calculated to describe the participant's demographics and the non-parametric tests, Mann-Whitney U and Kruskal Wallis, were used to determine if relationships existed between the variables. Among the participants, data indicated a significant difference between BMI and cardiovascular fitness ($z$ = -2.882, $p$ = 0.004). Results indicated that participants who had a higher calculated BMI, had a lower cardiovascular fitness level and participants who had a lower BMI, scored higher on the PACER and had a greater chance of being categorized in the Healthy Fitness Zone of cardiovascular fitness. Health-related fitness knowledge, however, had no statistically significant relationship to BMI or cardiovascular fitness. Age, gender, and ethnicity also were found to have no relationship to BMI, cardiovascular fitness, or health-related fitness knowledge. Results describe the need for additional research in the field of obesity and further examination of the effects of health-related fitness knowledge.

# CHAPTER I

# INTRODUCTION

Childhood obesity is one of the most urgent public health concerns of the 21st century (World Health Organization [WHO], 2013). As childhood obesity is on the rise, researchers are coming to terms with the increasing risks that overweight and obesity pose for children's health (Daniels, 2006). These risks include both immediate and long term, physical and mental health risks. Ultimately, overweight children are more likely to become obese adults (Phillips, 2012), speeding up the development of obesity related diseases, such as cardiovascular disease (American Obesity Treatment Association, 2013). Present health concerns also include type II diabetes mellitus (Centers for Disease Control and Prevention [CDC], 2013) and asthma, as well as other physical health problems with their gastrointestinal and skeletal systems (Daniels, 2006). Overweight children are also more likely to suffer from mental health problems and overall psychological stress (Must & Strauss, 1999). For the first time in history, children are living shorter lives than their parents (Daniels, 2006).

With childhood obesity on the rise, studies have begun to investigate the causes of this epidemic, focusing their attention on physical activity levels in children and adolescents. Physical activity levels have been shown to have an inverse association with the risk of obesity in Chinese youth (Hé et al., 2011). Unfortunately, physical activity levels in children, specifically young adolescents, are below the evidence-based physical education guideline amount of 60 minutes of moderate- to- vigorous- physical activity per day (Strong et al., 2005; Troiano et al., 2008). There are many things that can be attributed to these high levels of inactivity. Despite the widely publicized benefits of physical activity, sedentary behaviors and “screen” time, including television, video games, and computer use are becoming a way of living among adolescents (Mendelson, 2007).

The need for this trend of obesity and sedentary behaviors to be reversed is well acknowledged among researchers. Schools are a major source of opportunity to promote physical activity considering adolescents spend many of their waking hours at school (Mooney, 2012; WHO, 2013). Parents and peers also have the ability to influence adolescent’s physical activity attitudes and behaviors (Duncan, Duncan, Strycker, & Chaumeton, 2007). Parents hold significant influence in terms of modeling, involvement and facilitation (Edwardson & Gorely, 2010) while peers’ influence includes social support for physical activity, presence of peers, peer norms, acceptance, and affiliation (Fitzgerald, Fitzgerald, & Aherne, 2012). However, these influences can also become barriers. Adolescents can suffer from peer victimization and social isolation that can ultimately turn a child away from physical activity (Storch et al., 2007).

The decline in adolescent’s physical activity coincides with the current low levels of physical fitness in adolescents and the increasing rates of obesity (Cooper, 2010). Research shows that although all five aspects of physical fitness are important (body composition, cardiovascular fitness, flexibility, muscular strength, and muscular endurance), certain areas have greater associations with overweight and obesity then others (Ara, Moreno, Leiva, Gutin, & Casajús, 2007). Cardiovascular fitness, for example, shows a stronger association with overweight and total adiposity, compared to other physical fitness components such as muscular fitness, speed/agility, or flexibility (Ara et al., 2007). In regards to flexibility, studies have found contradicting results, some which show no association to weight status (Mak et al., 2010) and others, which show a negative association between flexibility and obesity (Prista, Maia, Damasceno, & Beunen, 2003). In studies that measure muscular strength and endurance, individuals that are overweight or obese typically perform poorer in both push-up and sit-up testing compared to their normal weight peers (Mak et al., 2010). However, these results must be interpreted cautiously, since lifting a greater body mass by overweight subjects involves higher energy costs (Deforche et al., 2003). The most common and adopted method for measuring weight status or obesity is through BMI (Phillips, 2012).

With this knowledge of an association between BMI and cardiovascular fitness, it is important to look at other aspects that might affect this relationship. Health-related fitness knowledge is one such aspect that should be considered. Organizations such as American Association for Health, Physical Education, Recreation and Dance (AAHPERD) and National Association of Physical Education and Sport (NASPE), have addressed the importance of health-related fitness knowledge for many years and it is puzzling that more attention is not being given to health-related fitness knowledge as a possible method for changing current physical activity and obesity trends (Keating et al., 2009). While knowledge alone might not be enough to change physical activity behaviors, the lack of health-related fitness knowledge has been suggested to be a factor for the continued obesity epidemic in adolescents (Zapata, Bryant, McDermott, & Hefelfinger, 2008). Therefore increasing health-related fitness knowledge may lead to the increase in physical activity behaviors (Keating et al., 2009). However, despite the importance of educating adolescents on health-related fitness knowledge, the few studies previously done show conflicting results (Fitzgerald, Singleton, Neale, Prasad & Hess, 1994).

## Statement of Problem

There is still much to learn in regards to childhood obesity. If researchers and health professionals desire to put an end to the obesity epidemic, there must be a thorough examination of all aspects that affect overweight and obesity. Although it is widely accepted that there is a strong correlation between youth's body mass index and cardiovascular fitness, to date, there have been no published studies that look at the relationship between body mass index, cardiovascular fitness, and health-related fitness knowledge in adolescents.

## Purpose of the Study

The purpose of this study was to examine the relationship between body mass index (BMI), cardiovascular fitness, and health-related fitness knowledge in diverse, low-income, Jr. High School aged students. The following research questions were also addressed:

1. Do adolescents with high BMI and low cardiovascular fitness have low health-related fitness knowledge?
2. Do adolescents with low BMI and high cardiovascular fitness have high health-related fitness knowledge?

3. Does ethnicity, age, or gender affect the strength of the relationship between BMI, cardiovascular fitness, and health related fitness knowledge?

## Limitations

1. Children had different prior experiences performing the PACER test.
2. Some students did not have adequate running shoes and/or running attire.
3. The results were reliant on each participant's comprehension of the questions that were administered in the validated health-related fitness knowledge test as well as their willingness to put forth effort into the PACER.
4. The researcher had no control over the curriculum or physical education classes provided to the students.

## Delimitations

1. Data was collected in the spring of 2013.
2. The study was delimited to students at one middle school located in Northern California.
3. The study included only 7th grade students.
4. All teachers assisting with data collection were presented with the same training protocols (Appendix A) to complete the assessments.
5. The researcher performed all of the PACER tests.
6. Data were collected using four measures: (1) BMI, (2) PACER, (3) health-related fitness knowledge exam, and (4) demographics provided by the school

Definition of Terms

The following terms were used in this study. Definitions are provided to provide understanding and ensure the terms are used with consistency.

1. Adolescence – a term commonly used to describe the time between childhood and adulthood. Adolescence is also equated to the term "teenage years" (US Department of Health and Human Services, 2013). For the sake of this study the term adolescence is used regarding the ages 10-15 years.

2. Body Mass Index (BMI) – BMI is calculated by the following equation:

$$\text{weight (kg)} / \text{height}^2 \text{ (m)}$$

3. BMI is a measure used to determine childhood overweight and obesity (CDC, 2013). It is an indirect measurement of adiposity and the resulting number is classified by the FITNESSGRAM® standards for Healthy Fitness Zones (Appendix B)

4. Child – a broad term used to describe any persons under the legal adult age of 18 years.

5. FITNESSGRAM® - "FITNESSGRAM is a complete battery of health-related fitness items that are scored using criterion-referenced standards. These standards are age and gender specific and are established based on how fit children need to be for good health" (Meredith & Welk, 2010, p. 1).

6. Health-Related Fitness Knowledge – knowledge relating to aspects of overall well being of health including but not limited to concepts of fitness, scientific principles, components of physical fitness, and effects of exercise on chronic disease risk factors (Zhu, Safrit, & Cohen, 1999).

7. Obesity – having a BMI greater than or equal to the 95th percentile for children of the same age and sex (CDC, 2013).

8. Overweight – defined as a BMI greater than or equal to the 85th percentile for children of the same age and sex (CDC, 2013).

9. PACER – "The PACER (Progressive Aerobic Cardiovascular Endurance Run) is the default aerobic capacity test in FITNESSGRAM. The test objective is to run as long as possible with continuous movement back and forth across a 15-meter space at a specified pace that gets faster each minute" (Meredith & Welk, 2010, p. 29)

10. Physical Activity – "Any bodily movement produced by skeletal muscles that results in energy expenditure" (Caspersen, Powell, & Christenson, 1985, p. 126).

11. Physical Education – physical education is aimed to provide knowledge and skills to students, that are needed to perform different physical activities, to maintain physical fitness, and to ultimately value physical activity as a part of a overall healthy lifestyle. Physical education includes, but is not limited to curriculum, instruction and assessment (Department of Education, 2013).

12. Physical Fitness – A set of independent attributes that are related to the ability to perform physical activities (Pate, 1988, p. 174).

# CHAPTER II

# REVIEW OF LITERATURE

The review of literature explores the following areas of study: (a) childhood obesity and health, (b) physical activity in children and adolescents, (c) physical activity influences, (d) school's influence, (e) parent's influence, (f) peer's influence, (g) relationship between physical activity and physical fitness, (h) benefits of physical fitness, (i) physical fitness levels, (j) body composition, (k) cardiovascular fitness, (l) flexibility, (m) muscular strength and endurance, (n) effects of culture on physical activity & physical fitness, and (o) knowledge of physical fitness. The chapter closes with a summary.

## Childhood Obesity and Health

There is an alarmingly high prevalence of childhood obesity in the United States as well as many other developing countries around the world. Since 1980, childhood obesity rates have nearly tripled (Phillips, 2012), indicating that approximately 17% of children aged 2-19 are obese (CDC, 2013), and even more are overweight or at risk. In 2010, the number of obese children was estimated to be greater than 42 million worldwide (WHO, 2013). The International Obesity Taskforce (2013) reported similar numbers, estimating that up to 200 million school-aged children are either overweight (a BMI above the $85^{th}$ percentile) or obese (a BMI above the $95^{th}$ percentile), and of those, 40-50 million are classified as obese. Prevalence of childhood overweight and obesity continues to increase at significant rates (Strauss & Pollack, 2001) and action must be taken to end this worsening trend. In addition, adolescence is a critical time, as it represents a proposed period for the development of obesity. This can lead to an increase of obesity-associated morbidity later in life (Dietz, 1994). Clearly, this epidemic is an urgent public health concern.

With obesity rates on the rise, understanding the implications of this disease are necessary and requires immediate attention from schools, parents, health care providers, and society as a whole. For example, childhood obesity has major affects on both short- and long-term mental and physical health. Overweight children often suffer from self-blame, negative body image, discrimination, and social stigmatization (Thé, 2006). When they experience rejection by their peers, it results in low self-esteem, which in turn, can impair academic and social functioning (Martin, Rhea, Greenleaf, Judd, & Chambliss, 2011; Phillips, 2012). Obesity also can induce feelings of shame and embarrassment, as well as overall psychological stress (Must & Strauss, 1999). In regards to the long-term effects, these negative feelings may increase susceptibility to eating disorders and other psychological disorders (Phillips, 2012). In a study done by Mustillo et al. (2003), the authors concluded that chronically obese children had significantly higher rates of oppositional defiant disorder in both boys and girls and significantly higher rates of depression in boys.

In addition to psychological complications, obesity can result in several negative physical health consequences (CDC, 2013). Some of these obesity-related conditions have an immediate effect on an individual’s health while other conditions have more chronic, long-term ramifications. Because of the high rates of overweight and obesity, children today, on average, live increasingly unhealthy and shorter lives than their parents (Daniels, 2006), and as the prevalence of childhood obesity increases, so do the related health concerns. Obesity affects various body systems including, but not limited to, the cardiovascular, metabolic, pulmonary, gastrointestinal and skeletal systems (Daniels, 2006). In addition to the increased risk of ill physical and mental health and, risk of adult obesity and ultimately premature death are also unfortunate results of childhood obesity (Phillips, 2012).

The cardiovascular system of an obese individual is largely affected by excess adipose tissue. Obesity, particularly severe obesity, is linked to abnormalities in both cardiac function and structure (Klein et al., 2004). The level of obesity as a child can accelerate the development of obesity-related cardiovascular disease (American Obesity Treatment Association, 2013; Daniels, 2006; Klein et al., 2004). Ultimately, cardiovascular disease is caused by the hardening of the arteries, which begins as a fatty streak and over time turns into a fibrous plaque on the artery's lining. The plaques have the potential to eventually lead to heart attacks or strokes by blocking blood flow (Daniels, 2006) and childhood obesity has the potential to speed up this process. Recent studies have suggested that today's children are experiencing higher blood pressure than children did in past decades (Muntner, He, Cutler, Wildman, & Whelton, 2004).

Obesity has proven itself equally detrimental to the metabolic system. Many metabolic disorders, including insulin resistance, metabolic syndrome, dyslipidemia, and type II diabetes mellitus have been linked to obesity (American Obesity Treatment Association, 2013; Klein et al., 2004). Health care professionals are finding an increasing number of children being diagnosed with type 2 diabetes mellitus and this increase is found to be parallel with the increasing incidence and severity of obesity (CDC, 2011; Pinhas-Hamiel, 1996).

Asthma is one of the most common respiratory diseases that children suffer from, and studies show this too has increased in line with the severity and prevalence of childhood obesity (Daniels, 2006). While one study found that children above the 85$^{th}$ percentile in BMI were at an increased risk of asthma regardless of gender, age, ethnicity, socioeconomic status, or exposure to tobacco smoke (Luder, Melnik, & DiMaio, 1998), contradicting studies have demonstrated that in fact, this relationship between asthma and BMI may be affected by socioeconomic status, tobacco use, or other unknown variables (Rodriguez, Winkleby, Ahn, Sundquist, & Kraemer, 2002). Recent research shows that obesity may also lead to problems in the gastrointestinal system including liver disease and gastro-esophageal reflux disease, as well as skeletal abnormalities due to excess body weight (Daniels, 2006).

Although this just begins to scratch the surface of obesity related diseases and complications, it is clear that this problem must not be taken lightly. Prevention methods must be carefully weighted out, both pros and cons, when determining the best weight management techniques for each individual. Physical activity, along with proper nutrition can help prevent and treat obesity-related disease risk factors and should be considered a primary method of therapy for overweight and at risk individuals (Klein et al., 2004).

## Physical Activity in Children and Adolescents

With obesity rates on the rise, it is important to look at the factors that are causing such a notable increase. Obesity experts agree that excessive weight gain is a result of a positive energy balance, which means that the energy the individual intakes surpasses the energy expenditure on a regular basis (Shriver et al., 2011). There are two main factors that affect energy balance: nutrition and physical activity. Although previous research has shown that caloric restriction can be a successful means to achieve an energy balance, this method is not always best for children due to their psychological, nutritional, and physiological needs (Spruijt-Metz, Lindquist, Birch, Fisher, & Goran, 2002). Physical activity must then be increased to restore energy balance and prevent the worsening trend of weight gain (Kopelman, 2000). Evidence-based physical education guidelines recommend children engage in a minimum of 60 minutes of moderate- to vigorous physical activity every day (Strong et al., 2005). Yet despite the known physical activity benefits, many children do not engage in the recommended amount of activity. Physical activity levels are at an unfortunate low, while sedentary behaviors like television watching, Internet surfing, and video game playing are becoming the more popular choice among children and adolescents (Mendelson, 2007).

Low levels of physical activity (PA) have been thought to be associated with an increased risk of obesity (Hé et al., 2011). With modern technology, children's physical activity (both organized and spontaneous) has declined while their "screen" time has increased (Mendelson, 2007). In one study, the authors found that only 8% of 12-15-year-olds met the physical activity recommendations of attaining at least 60 minutes per day of moderate-to-vigorous physical activity (Troiano et al., 2008). Similar studies examining Canadian children, reported that less then half of Canadian youth were getting the minimal recommended level of 60 minutes of physical activity a day as well as undertaking in long hours of inactivity. Half of their subjects reported watching more than four hours of television per day and 30% reported that they spend more then three hours per day on the computer (Boyce, 2004). Trilk and colleagues (2012) looked at the relationship between sedentary patterns and physical activity in Jr. High school girls and found that as girls transitioned from seventh to eighth grade, the amount of time they spent engaging in sedentary behaviors increased, while leisure physical activity decreased significantly. Overall, they found low levels of physical activity as well as declining physical activity over time for adolescent girls. In a study that examined weight control beliefs and physical activity, the results indicated that middle school children are concerned about weight and exercise, yet continue to get bigger and exercise less (Martin et al., 2011). Physical activity levels decline through childhood and adolescence, with the end of primary school and beginning of middle school/Jr. High, being a critical period of potential change (Trost et al., 2002). Therefore understanding what influences children's physical activity, at this particular age, is essential.

## Physical Activity Influences

Increasing understanding of the factors that influence student's enjoyment of physical activity allows for the development of health promotion programs that target youth. World Health Organization's (WHO Europe, 2013) recommendations for preventing and managing obesity, emphasizes the need for early prevention and to establish lifelong healthy eating and physical activity patterns. However, it is unclear as to what or whom can best influence such patterns. Who holds the responsibility to get children up and moving? Family, school, peers, and health services all play an essential role in the development of healthy habits in youth. The national Department of Health has an important role to play in overseeing the delivery of health services. All encounters with health services should be used as an opportunity to promote and encourage healthy eating and active living (Mooney, 2012). The time spent in these facilities, however, is often limited.

## School's Influence

The majority of children spend the first two decades of their lives, and a substantial number of their waking hours during the week, in school. Therefore, increased opportunities exist to provide health education and promotion during this time (Mooney, 2012). Schools are a crucial setting where children have the opportunity to be active and there has been an increased focus on schools to promote and facilitate physical activity (WHO, 2013). Typically, a student has two opportunities to be engage in physically active during a school day: recess/lunch breaks and physical education classes. Evidence reinstates the need for physical education classes and the opportunities it provides for a student's daily physical activity (Morgan, Beighle, & Pangrazi, 2007). However, with the push for higher test scores and unfortunate budget cuts, the trends show a decrease of frequency of physical education in schools (Lowry, Wechsler, Kann, & Collins, 2001). This pushes the importance onto recess. However, despite the fact that recess provides ample amount of possibilities of PA, as little as 20% of recess is actually spend in engaging in PA (Sallis & Patrick, 1994).

## Parent's Influence

Parents also have a significant influence on a child's PA. Their mechanisms for influence include encouragement, parental attitudes, role modeling, involvement in activities and facilitation such as transportation and paying fees (Edwardson & Gorely, 2010). In adolescents, cross-sectional research shows that parental modeling, attitudes, transportation and overall support showed a positive relationship with PA levels (Edwardson & Gorely, 2010). In terms of modeling, numerous studies show that if a child has one parent that is obese, that child is three-times more likely to become obese compared to a child whose parents are of normal weight. In a family where both parents are overweight, the risk increases ten-fold (Thé, 2006). Parents need to be aware of their potential influences and be encouraged to be positive role models for their children in regards to physical activity and weight control. If they are not careful, they can unknowingly have negative affects on their children's attitudes and beliefs of physical activity (Gray, Janicke, Ingerski, & Silverstein, 2008).

## Peer's Influence

Although parents can greatly influence their children's physical activity levels, as children become older and move towards adolescence, they spend an increasing amount of time with peers, enhancing the potential influence of peers on their physical activity levels and attitudes (Duncan, Duncan, Strycker, & Chaumeton, 2007). Researchers have considered numerous ways in which peers may influence physical activity behaviors among their peers including: social support for physical activity, participation of similar physical activity, peer norms, peer acceptance, peer crowd affiliation, and peer victimization (Fitzgerald, Fitzgerald, & Aherne, 2012). In a study on rural adolescent girls, Beets, Pitetti, and Forlwa (2007) found that peer support, in addition to being directly related to physical activity, it was also related to an increase in self-efficacy and the ability to overcome personal barriers (e.g., feeling tired, too busy). Young adolescents, aged 10- and 11-years from the UK responded that socializing was their number one motivation for being active (Brockman, Jago, & Fox, 2011). When asked why they take part in active play, children's responses included: "*Because I like being with my friends"* and *"Because I like meeting people outside that you wouldn't see normally and playing games with them, that you can't really do in the house"* (p. 3).

Just as easily as someone can be a positive influence on a child's physical activity, they can become a barrier. Peers are one example of an influence that can often do more harm then good. Peer victimization and social isolation can result in a child being turned away from physical activity (Storch et al., 2007; Gray et al., 2008). Storch et al. (2007) found significant negative correlations between physical activity and loneliness. Additionally, there can also be a fear factor in regards to peers. When asking children about their perceived constraints, some included fear of being picked on by older "scary" children (Brockman et al., 2011).

Socioeconomic characteristics of schools and communities can also become a barrier to PA for children. One study that surveyed Hispanic parents of young teenagers found that Hispanic's participation included barriers such as expenses related to PA (62.3%), transportation issues (36.9%), and not having PA opportunities available in their neighborhoods or communities (30.8%; Duke, Huhman, & Heitzler, 2003). Underserved neighborhoods may not be able to offer as many organized sport programs due to financial burdens. In addition, the issue of safety may also become a barrier if a community does not have access to safe areas for children to play. In low-income schools, Institutional Physical Education (PE) barriers include a crowded curriculum, time constraints, and lack of access to sufficient budget and sporting equipment (Hardman, 2008; Wright, 2011).

## Relationship Between Physical Activity and Physical Fitness

It is important to understand the relationship between physical activity and physical fitness. People often mistake them for synonym terms, but they have very important differences. There are several ways to define both physical activity and physical fitness. Caspersen et al. (1985) defines physical activity as “any bodily movement produced by skeletal muscles that results in energy expenditure” (p. 126) where as physical fitness is “a set of attributes that are either health- or skill-related” (p. 128). In a similar definition, physical fitness is described as our body’s ability to be capable to perform certain physical activities including, but not limited to, cardiovascular fitness, muscular strength and endurance, speed, flexibility, and balance (Pate, 1988; Ortega, Ruiz, Castillo, & Sjostrom, 2008). In regards to physical activity and physical fitness levels, studies have shown that low level’s of physical activity coincides with low physical fitness in adolescents (Cooper, 2010).

## Benefits of Physical Fitness

Being physically fit has many positive benefits in both adults and children. Cardiovascular health can be improved by combined efforts of cardiovascular and muscular fitness while both employ a positive effect on the cardiovascular system not only in adults but also in children (Ortega et al., 2008). There is also strong evidence indicating that adolescence physical fitness is positively related to skeletal bone health at their present age as well as later in life (Hallal, Victora, Azevedo, & Wells, 2006). One study's results indicate that in young adults, the bone mineral content of the whole body was directly associated with several aspects of physical fitness, including respiratory fitness, muscular fitness, and speed/agility (Vincete-Rodriguez et al., 2008).

Physical fitness also effects mental health. Mental health can be define as how individuals think, act, and feel, as they go through life, and similar to adults, adolescents and children can also experience mental health disorders including anxiety, depression, or personality disorders (Ortega et al., 2008). Research has compelling evidence that shows self-esteem being positively affected by physical fitness (Ortega, et al., 2008) as well as mental health as a whole (Hallal et al., 2006).

Physical fitness can often be used as a useful health marker in adolescence, and the number of physical and mental health benefits reinforces the need for physical fitness testing for monitoring health (Morrow, Fulton, Brener, & Kohl III, 2008). Physical fitness enhancement, including high intensity training and moderate- to vigorous-physical activity should be a major goal in public health promotion (Ortega et al., 2008). It is important to remember that physical fitness involves an array of fitness, including cardiorespiratory fitness, muscular fitness, speed/agility, balance and flexibility. In hope to acquire overall fitness of an individual, all of these types of fitness must be promoted and incorporated into our schools and health education programs.

## Physical Fitness Levels

Since World War II, there has been an increasing interest in the fitness levels of our nation's youth (Morrow, 2005). This interest stemmed from the perception of lack of military preparedness and the reporting of Kraus and Hirschland (1954), declaring American youth were less fit than European youth. This ultimately led to the American Association for Health, Physical Education and Recreation and Dance (AAHPERD) Youth Fitness test. This test is better known as the "President's Physical Fitness Test," which was the first attempt at a nationwide physical fitness testing in the United States (Morrow et al., 2008). Over time, fitness tests have been modified and changed, and additional tests have been added to best capture the health of our youth. Across the United States, 76.8% of schools administer physical fitness tests, even if they are not specifically required to do so. Among these schools, the President's Challenge and FITNESSGRAM® are the most common choices for fitness tests (Keating & Silverman, 2004).

Due to the concern for rising obesity and perceived lack of physical fitness in youth, physical education teachers have an interest in physical fitness levels as well as the developing statewide mandates that require such testing (Morrow et al., 2008). In 2007-2010 more than 2.5 million Texas students in grades 3-12 completed the FITNESSGRAM® physical fitness testing each year, including testing in the areas of aerobic capacity, body composition, muscular strength and endurance, and flexibility (Morrow, Martin, Welk, Zhu, & Meredith, 2010). This data showed that as children got older, fitness levels decreased in both boys and girls with a higher percentage of girls passing all 6 FITNESSGRAM® tests compared to boys in the same grade (Cooper, 2010). For sixth grade students the percentage of students who achieved Healthy Fitness Zone ™ on all 6 FITNESSGRAM® tests averaged 27.6% for girls and 20.2% for boys. For seventh graders the percentages dropped to 25.5% for girls and 19.7% for boys. Eight grade girls dropped to 22.1% while there was a slight raise in the boys to 20.5% passing all 6 fitness tests (Cooper, 2010).

Aside from the FITNESSGRAM® and President's Challenge, there are additional studies that show comparisons between weight status and fitness levels. A study looking at 3000+ Hong Kong students aged 12-18 found that overweight and obese students performed poorer in push-up, sit-up (muscular fitness) and endurance running (cardiovascular fitness) compared with normal weight (Mak et al., 2010). The authors also found no significant difference between normal weight and overweight/obese in the sit-and-reach results, which contradicts other studies. Leyk et al. (2012) looked at subjects aged 10 to 25 and found that those who had the best performance on the chin-ups and the 1000-meter run were subjects without any cardiovascular risk factors (overweight, lack of exercise, smoking). Performance then notably deteriorated with the presence of risk facts, particularly the number of risk factors. Moreira et al. (2011) also examined risk factors in regards to physical fitness in Azorean adolescents and found that daily step counts and physical fitness levels were negatively associated with having one or more metabolic risk factor.

## Body Composition

Weight status is often measured and used in the overall acknowledgement of physical fitness. Body mass index (BMI) is the most common and widely adopted used method for measuring weight status or obesity, and the often the best and most available way to measure obesity levels in a large group setting (Phillips, 2012). In children, there is no specific cutoff point to indicate obesity; instead, there are gender-specific growth reference charts that are used to interpret BMI measurements. The BMI growth charts are both cautious and conservative, therefore children who are above the cut off are almost certainly excessively fat and at increased health risk (Phillips, 2012). In the past 30 years, there has been a reported increase in BMI growth. In a study looking at 70 years of BMI data showed that children born in 1973-1999 had the largest BMI values from 8 years of age and onward, compared to the other cohorts (Johnson et al., 2012). The amount of children with a BMI above the $85^{th}$ percentile cutoff point is also increasing rapidly (Troiano, Flegal, Kuczmarski, Campbell, & Johnson, 1995). Overall, there have been clear BMI growth curve shifts after 1970 and are present in childhood obesity rates today (Johnson et al., 2012).

## Cardiovascular Fitness

Cardiovascular fitness or referred to by some as cardiorespiratory fitness is one of the many types of bodily functions that can be measured and is considered an important aspect of an individual's physical fitness. Cardiovascular fitness is the overall capacity of the cardiovascular system as well as the respiratory system to provide oxygen and carry out prolonged exercise (Ortega et al., 2008). Cardiovascular fitness can also be defined as the direct measure of maximum oxygen uptake (e.g., $VO_{2max}$) (Faulkner, 2010). Although there is an important genetic factor involved in cardiovascular fitness, it can be greatly affected by lifestyle (Mori et al., 2009). In regards to children, cardiovascular fitness is a very important aspect of fitness and is often considered an independent marker of health (Ortega et al., 2008).

Cardiovascular fitness is markedly impaired in overweight individuals compared to those with normal weight status. According to the 1999-2002 National Health and Nutrition Examination Survey (NHANES) studies, regardless of sex, those in the normal weight group had higher fitness levels compared to those in the risk or overweight and overweight groups (Pate, Wang, Dowda, Farrell, & O'Neill, 2006). He et al. (2011) also found that regardless of gender, aerobic fitness was significantly inversely associated with body weight gain over an 18-month period as well as significant associations present between CRF and BMI in both boys and girls, with boys having a stronger significance. The authors also found that boys who had low CRF had a significant increase risk of becoming or remaining overweight compared to those with high CRF. In a different study, Rowland (1991) investigated 27 young females and found that as fatness increases, oxygen consumption and treadmill running declines.

There are many ways to test cardiovascular fitness, however, the Progressive Aerobic Cardiovascular Endurance Run (PACER) and One-mile run have become the most popular. The PACER, which has also been referred to as the multistage fitness test, is found to be reliable field test in children and adolescents and is a useful way to measure cardiorespiratory fitness (CRF) capacity (Mahoney, 1992; Morrow, Martin, & Jackson, 2010). During this test, subjects are asked to run back and forth on a 20-meter course as a speed, which is pre-determined by audio signals. $VO_2$ is derived from the level and number of laps completed, and used as a measure of CRF (Matsuzaka et al., 2004).

## Flexibility

Maintaining adequate joint flexibility is important in the functional health of the musculoskeletal system (Meredith & Welk, 2010). However, children do not typically struggle in the area of flexibility when it comes to their fitness, instead is it something students should be informed about as being important as they age (Meredith & Welk, 2010). Since most students will easily pass a flexibility test, like that which is administered in the FITNESSGRAM® (Meredith & Welk, 2010), it is questioned whether flexibility is a good portrayer of overall fitness?

In comparing flexibility test results to weight status, results are inconsistent. Studies show that overweight/obese adolescents had similar sit-and-reach results as their normal weight peers (Mak et al., 2010). These results are in contrast to a study that showed better sit-and-reach results were achieved by overweight compared to normal weight girls (Prista et al., 2003).

## Muscular Strength and Endurance

Muscular strength and endurance are often combined into one more inclusive fitness category (Meredith & Welk, 2010). It is equally as important as muscular flexibility because of the importance to have strong muscles that can work forcefully over a long period of time (Meredith & Welk, 2010). Although studies show that overweight and obese performed poorer in both push-up and sit-up testing compared to normal weight, such differences must be interpreted cautiously (Deforche et al., 2003; Mak et al., 2010). Lifting a greater body mass by overweight subjects involves higher entry costs compared to normal weight subjects (Deforche et al., 2003).

## Effects of Culture on Physical Activity and Physical Fitness

Culture, or acculturation is one extrinsic barrier that can play a part in the physical activities of a child (Luder et al., 1998). Acculturation is the result of groups of individuals of one culture, having continuous first-hand contact with a second culture, at which point changes occur in the original cultural patterns of either or both groups. Culture and cultural preference are part of the social environment within the family, school, and community, and have a strong influence on PA (Wright, 2011).

In today's culture, the extensiveness of obesity is high, and in minority groups, it is often found at even greater levels (Luder et al., 1998). In a study looking at inner city black and Hispanic children, the authors found that 32.9% had a BMI in the 85$^{th}$ percentile or greater and 15.3% had a BMI in the 95$^{th}$ percentile or greater (Luder et al., 1998) both which are above the national average (Troiano, Flegal, Kuczmarski, Campbell, & Johnson, 1995). In the neighborhood of Harlem, which is predominately African American, a study has found percentages of overweight higher than the national averages; 14% of children between the ages of 5 and 11 years had a BMI above the 95$^{th}$ percentile (Okamato, Davidson, & Connon, 1993). This is notably higher than the recent publication of the National Health and Nutrition Examination Surveys (NHANES) III, which found a prevalence of 10.9% of children above the 95 percentile (Troiano et al., 1995).

Racial disparities are also found to exist among childhood physical activity levels, specifically for Hispanic young adults. A study that looked at 9- to 13-year-olds found that Hispanics were less likely to participate in both organized sports and free time physical activity (Duke, Huhman, & Heitzler, 2003). Wright (2011) additionally found that English-speaking children participated in more physical activity than children whose primary language was Spanish. Understanding the racial and ethnic disparities in child physical activity and fitness is important in helping healthcare workers provide more accurate information to their patients on ways to promote physical activity, and means to prevent childhood obesity.

## Knowledge of Physical Fitness

Due to the necessity to increase physical activity and physical fitness, it is critical to educate children in regards to health-related fitness knowledge to help future generations adapt to healthy lifestyles. However, it is unclear why actions have not been taken to address this necessity among adolescence (Keating et al., 2009). There have been brought to light several difficulties regarding the measurement and analysis of health-related fitness knowledge and physical activity and/or physical fitness. First off, the lack of consistency in passing values on health-related fitness tests for student is startling. How much knowledge is enough knowledge? Without a general, agreed upon, passing percentage, it is impossible to summarize results across studies. This gap in knowledge will likely hinder our ability to understand the effect that health-related fitness knowledge plays in student's physical activity levels, beliefs, and attitudes (Keating et al., 2009)

Despite claims regarding the importance of health-related fitness knowledge, studies have not always shown that to be true (Fitzgerald, Singleton, Neale, Prasad, & Hess, 1994). In fact, the few attempts that have been made to understand the relationship between health-related fitness knowledge and physical fitness/activity in adolescence show conflicting results. Dilorenzo et al. (1998) found that in 5th and 6th grade students, health-related fitness knowledge was a significant determinate of their physical activity level. On the other hand, there was no significant correlation between health-related fitness knowledge and physical activity in middle school students (Ferguson, Yesalis, Pomrehn & Kirkpatrick, 1989). This inconsistency between studies makes it difficult to understand the relationship between the two variables.

In a more recent study, Placek and colleagues (2001) assessed middle school health-related fitness knowledge using qualitative methods. The students were asked questions regarding the importance of exercise, fitness components and exercises that could improve those components, and exercise principles. The authors concluded that many middle school students had grave misconceptions regarding fitness and thought being fit and being skinny were the same thing. Surprisingly, these misconceptions are not new and students had the same misguided ideas over 20 years ago (McArdle, Katch, & Katch, 1986).

Why is there so much misunderstanding and lack of knowledge in this area of study? One explanation is that unlike most subjects in school, physical fitness rarely uses homework as an aid to help the students learn (Keating et al., 2009). However, that is just one hypothesis. It is not enough to simply claim children do not process the adequate amount of knowledge to be physically active, we must also understand why. Ultimately, health-related fitness knowledge is a largely unexplored area of study and more research must be done in its field.

## Summary

Childhood obesity is an impending epidemic and while overweight children and adolescents are becoming increasingly more common, physical activity and physical fitness levels are declining. These facts alone have huge implications on children and adolescents now, as well as future generations. Cardiovascular fitness is a very important marker in overall fitness level in children and adolescents (Ortega et al., 2008). In a related area of study, health-related fitness knowledge is an important, unexplored area of study. Educating youth on the necessity of physical activity and physical fitness needs to become a priority for parents, educators, and health professionals.

# CHAPTER III

# METHODOLOGY

The purpose of this study was to examine the relationship between body mass index (BMI), cardiovascular fitness, and health-related fitness knowledge in diverse, low-income, Jr. High School aged students. This chapter provides information on the setting, participants, instrumentation, data collection, and data analysis.

## Setting

This study took place in a small town in the northern valley of California. The local community has a population of 5,382 according to the 2010 census and is considered rural and low income, with a median household income of $41,264 in 2009 (City-Data, 2012).

The physical education program at the school consisted of three physical education teachers, one for each grade, $6^{th}$, $7^{th}$, and $8^{th}$. The students took part in their physical education class for one period during each school day, which consisted of roughly fifty minutes each day. Fitness testing is completed three times each year for every $7^{th}$ and $8^{th}$ grade student, typically at the end of each semester. Although there is no formal, set curriculum, the $7^{th}$ and $8^{th}$ grade physical education teachers have created a combined curriculum over the years to meet all of the California state standards. The two classes are taught together and the lessons focus on the health benefits of physical activity and sport. The classes are taught in 2-week units (e.g., softball, weight lifting, dance, basketball, etc.) and at the end of each unit the students are required to write a 1-page paper, are quizzed on the material, and complete a timed ½ mile run.

## Participants

In the 2012-2013 school year, the school served 402 students between three grades; sixth (146 students), seventh (138 students), and eighth (118 students). The students were predominately White (40.8%) followed by Hispanic or Latino (34.1%) and 14.7% were two or more races. This school was considered low income, with 83.1% of students classified as socioeconomically disadvantaged (SARC, 2013). Because of factors beyond the control of the researcher, only 7$^{th}$ grade students were included in this study. Any 7$^{th}$ grade student who attended the Jr. High school, and was enrolled in the physical education class was eligible to participate in this study.

## Instrumentation

Data were collected using four techniques. Height and weight were measured to calculate BMI, a PACER test was used to measure cardiovascular fitness, a survey was administered to assess health-related fitness knowledge, and demographics, including, gender, birthday, and ethnicity were provided by the school during data collection.

### Body Composition

Body composition was measured using BMI. Estimates of body composition based off height and weight, such as BMI, can result in a possible 5% to 6% error since body weight reflects muscle and bone mass and not just fat mass (Lohman, 1992). However, BMI is a widely adopted method for measuring body composition and the best way to do so for large groups of youths (Phillips, 2012). Height and weight were collected using a portable Seca ® scale and stadiometer. Weight was measured to the nearest 0.1 lb. Height was measured twice to the nearest 0.25 inch. A third height measurement was then taken if the first 2 measurements were not within 0.25 inches. An average of the 2 consistent measurements were used for analysis. Measurements were taken with no shoes, no bulky clothing, and each student correctly positioned. Measurements were recorded on the provided form (Appendix D). Body mass index (BMI) was calculated by dividing weight (kg) by height squared ($m^2$). Children were then categorized into one of three zones based on BMI, age, and gender: Healthy Fitness Zone, Needs Improvement, and Needs Improvement – Health Risk zone. The Healthy Fitness Zone was established by determining body fat values that indicated a low risk for potential health problems (Meredith & Welk, 2010). The body composition standards were established with the use of the National Health and Nutrition Examination Survey (NHANES) data and then equated to corresponding BMI values (Meredith & Welk, 2010).

Cardiovascular Fitness

Cardiovascular fitness (CVF) was assessed using the 15-meter multi-staged fitness test, also referred to as the Progressive Aerobic Cardiovascular Endurance Run (PACER). The PACER is a valid and useful measure of cardiovascular fitness and has been found to be reliable for children and adolescents (Mahoney, 1992). On a marked off 15-meter course, subjects were instructed to run back and forth, at a pre-determined speed and guided by audio signals. The running speed increases at 0.5 km/h each minute, from a start speed of 8.5 km/h. Groups of up to five subjects ran at a time, following the audio signal and trying to complete as many laps as possible, until they could not keep up with the given pace (Meredith & Welk, 2010). Scores were marked on the given scorecard (Appendix E). The level (maximum speed) and number of laps completed in the test were then used as an estimated measure of aerobic capacity, or CVF. Based on the estimated aerobic capacity from the PACER test, students were placed in one of two categories: The Healthy Fitness Zone, or out of the Healthy Fitness Zone. Each age requires a different number of laps completed to be considered in the Healthy Fitness Zone for aerobic capacity, and these numbers differ between BMI, age, and gender (Appendix F).

Health-Related Fitness Knowledge

Students were asked to complete a 20 question, Physical Education Cognitive Assessment (South Carolina Physical Education Assessment Program [SCPEAP], 2007; Appendix G), which was used to measure their physical education knowledge about physical fitness. The test was developed and validated by the SCPEAP group, a collaboration of middle school teachers and University professors. It was developed and piloted in the spring of 2001 (SCPEAP, 2007). The test consisted of a matching section and a multiple-choice section. Each section consisted of ten questions. The students had 20 minutes to complete their test. When grading the assessments, the students were awarded 1 point per correct answer and received a score between 0 and 20 (SCPEAP, 2007).

# Data Collection

Data Collection Help

Prior to any data collection, physical education teachers were asked to assist the researcher with the data collection. Several days before data collection began the physical education teachers were informed of the purpose and design of the study as well as the expectations and specific duties of their roles. The physical education teachers both had previous experience with the data collection techniques that were used. Both teachers were given a training manual (Appendix A), which specifically informed them on all the testing protocols. Both physical education teachers practiced height and weight collection for the researcher to ensure consistency.

Consent

Prior to data collection the researcher obtained permission from the principal of the school as well as the physical education teachers from both 7$^{th}$ and 8$^{th}$ grade. Once permission was granted, active informed consent forms (Appendix C) were given to every 7$^{th}$ grade student in a physical education class. The forms required signatures by each student's parent or guardian and had to be brought back in the allotted time. For those students who were eligible, their results and information were kept confidential and remained anonymous. No one besides the researcher and teacher assistants had access to these files.

Assessments

The researcher, with the assistance of the physical education teachers, conducted two parts of the assessment in the school gymnasium during regular physical education classes, the PACER run and the BMI testing. Prior to participating, the researcher informed all students (prior to their physical education class beginning) on the voluntary, anonymous, and confidential nature of the study. Any student who did not have parental consent or choose not to participate in the study, sat quietly and watched the other students perform the assessments. Two assessment stations, (1) BMI (height and weight collection), and (2) PACER, were set up and participants first got their height and weight recorded and then waited for their turn to complete the PACER run. The data collection took place over several days until all classes were complete.

Data were then taken back to the CSU Chico, Center for Nutrition and Activity Promotion office. There it remained in a file cabinet that only the researcher had access to. After data entry and accuracy checks were completed, all identifiers were removed.

## Data Analysis

To protect the student's privacy, the names of the participants were transformed into digits before conducting any analysis. Data were analyzed using SPSS version 20. Initially, descriptive stats were calculated for all demographics of subjects including age, gender, and ethnicity to describe the sample. A Kruskal-Wallis test was used to determine if there were significant differences between BMI and health-related fitness knowledge. Similarly, a Mann-Whitney U test was used to determine if there were significant differences between cardiovascular fitness and health-related fitness knowledge. Kruskal-Wallis tests were also used to compare ethnicities in regards to BMI, cardiovascular fitness, and health-related fitness knowledge as well as to test for differences between ages in regards to BMI, cardiovascular fitness, and health related fitness knowledge. Similarly, a Mann-Whitney U test sought to find differences between gender in regards to BMI, cardiovascular fitness, and health-related fitness knowledge. Finally a Mann-Whitney U test was used to find significant differences between BMI and Cardiovascular fitness. For each test, the relationship was considered significant at an alpha level $p \leq .05$.

# CHAPTER IV

# RESULTS AND DISCUSSION

The purpose of this study was to examine the relationship between body mass index (BMI), cardiovascular fitness, and health-related fitness knowledge in diverse, low-income, Jr. High School aged students. This study sought to examine the following research questions: Do adolescents with high BMI and low cardiovascular fitness have low health-related fitness knowledge? Do adolescents with low BMI and high cardiovascular fitness have high health-related fitness knowledge? Does ethnicity, age, or gender affect the strength of the relationship between BMI, cardiovascular fitness, and health related fitness knowledge? Chapter IV is divided into two sections. The first section includes the results of the study including participant's demographics, data, graphs, and tables. The second section includes the discussion of the results.

## Results

### Participant Demographics

Of the 138 7th grade students attending the school, 88 students returned consent forms. Participants without parental permission were excluded from the analysis. Complete data were analyzed for 60 participants (50% female, 50% male) ages 12-14 years old. The sample included 46.7% white (not Hispanic), 33.3% Hispanic or Latino, and 20% other ethnicities. Thirteen participants were 12 years old (21.7%), forty-two participants were 13 (70%), and five participants were 14 (8.3%). The average age was 12.9 years. Table 1 provides descriptive characteristics of all participants.

Table 1

*Participant Demographics*

| | *n* | Variables | Mean | ±S.D. |
|---|---|---|---|---|
| Gender | | | | |
| Girls | 30 | Height | 61.7 | 0.42 |
| | | Weight | 130.8 | 7.58 |
| | | BMI | 24.1 | 1.34 |
| Boys | 30 | Height | 63.8 | 0.51 |
| | | Weight | 127.9 | 5.4 |
| | | BMI | 22 | 0.77 |
| Age | | | | |
| 12 | 13 | Height | 62.2 | 0.63 |
| | | Weight | 122 | 5.71 |
| | | BMI | 22.1 | 0.99 |
| 13 | 42 | Height | 62.9 | 0.46 |
| | | Weight | 130.2 | 5.02 |
| | | BMI | 23.1 | 0.86 |
| 14 | 5 | Height | 62.5 | 1.02 |
| | | Weight | 141.5 | 35.6 |
| | | BMI | 25.2 | 5.9 |
| Ethnicity | | | | |
| White (not Hispanic) | 28 | Height | 63.2 | 0.51 |
| | | Weight | 121.5 | 4.66 |
| | | BMI | 21.3 | 0.62 |
| Hispanic or Latino | 20 | Height | 62.3 | 0.62 |
| | | Weight | 142 | 10.8 |
| | | BMI | 25.7 | 1.83 |
| Other | 12 | Height | 62.5 | 0.88 |
| | | Weight | 126.7 | 8.54 |
| | | BMI | 22.9 | 1.65 |

*Note.* (*n* = 60); Age (yrs); Height (in); Weight (lbs)

<u>Body Composition</u>

BMI is categorized into three fitness zones: Healthy Fitness Zone, Needs Improvement, and Needs Improvement – Health Risk. The break down of each zone is dependent upon both gender and age and can be seen in Table 2. Figure 1 indicates the frequency of BMI between the three fitness zones for all participants. Thirty-seven participants (61.7%) were categorized into the Healthy Fitness Zone, eleven participants (18.3%) were categorized into the Needs Improvement, and twelve participants (20.0%) were categorized as Needs Improvement – Health Risk. Figure 2 depicts the distribution of males and females by percentage in each of the three BMI fitness zones. Similarly, Figure 3 represents ethnicities within BMI fitness zones, and Figure 4 identifies age among the three BMI fitness zones.

Table 2

*BMI fitness zone breakdown (FITNESSGRAM Performance Standards, 2013)*

| Age | Needs Improvement - Health Risk | Needs Improvement | Healthy Fitness Zone |
|---|---|---|---|
| | | Female | |
| 12 | ≥ 25.8 | ≥ 22.2 | 22.1 – 15.2 |
| 13 | ≥ 26.8 | ≥ 23.0 | 22.9 – 15.7 |
| 14 | ≥ 27.7 | ≥ 23.7 | 23.6 – 16.2 |
| | | Males | |
| 12 | ≥ 24.7 | ≥ 21.4 | 21.3 – 15.3 |
| 13 | ≥ 25.6 | ≥ 22.3 | 22.2 – 15.8 |
| 14 | ≥ 26.5 | ≥ 23.1 | 23.0 – 16.4 |

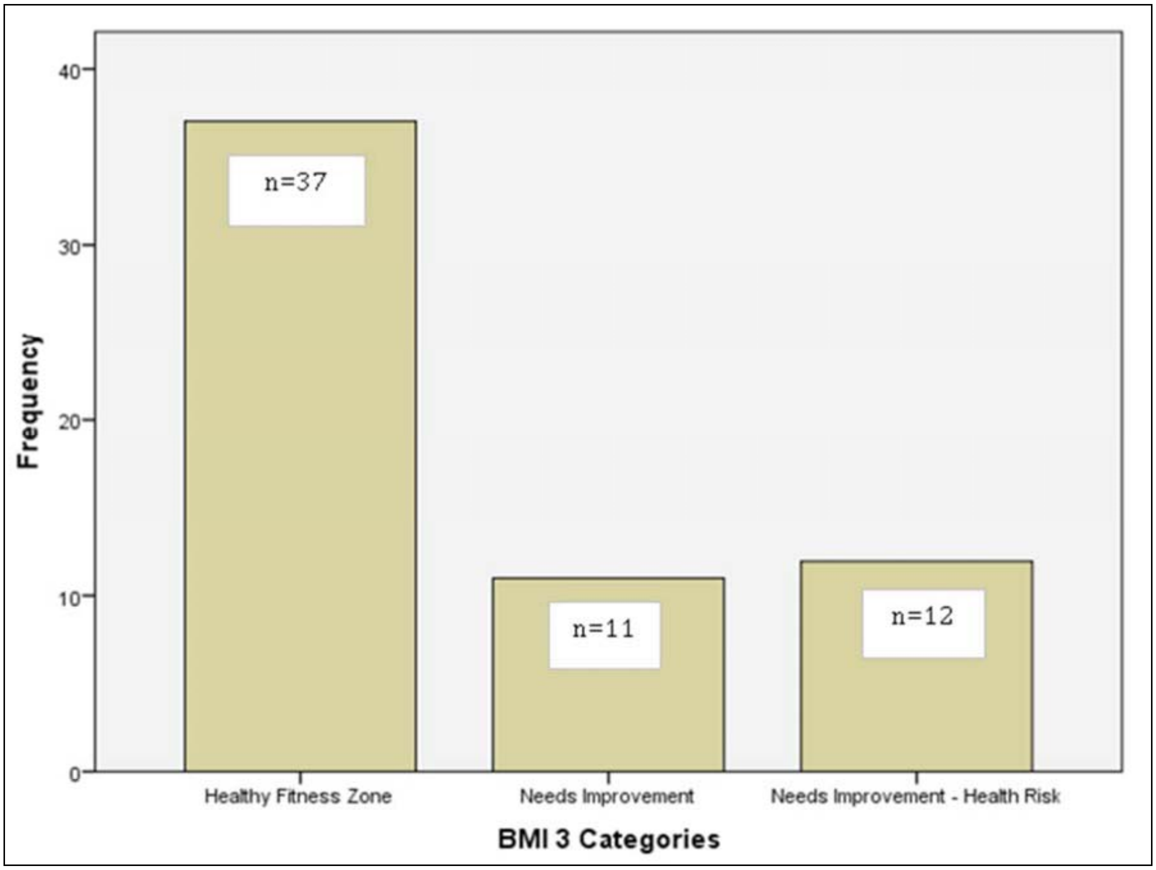


*Figure 1.* Frequency of BMI fitness zones for all participants.

Cardiovascular Fitness

Cardiovascular fitness was assessed utilizing the 15-meter PACER test (Meredith & Welk, 2010) and were scored based on the number of laps completed. All testing took place in the school gymnasium, with 15 meters marked off with tape that was measured once and stayed in place until the completion of testing. Testing protocol was followed, which was in concert with the information provided to the physical education teachers prior to data collection (see Appendix A). Based on the subject's gender, age, and laps completed, each student was sorted in either the Healthy Fitness Zone or out of the Healthy Fitness Zone in accordance with Fitnessgram published standards

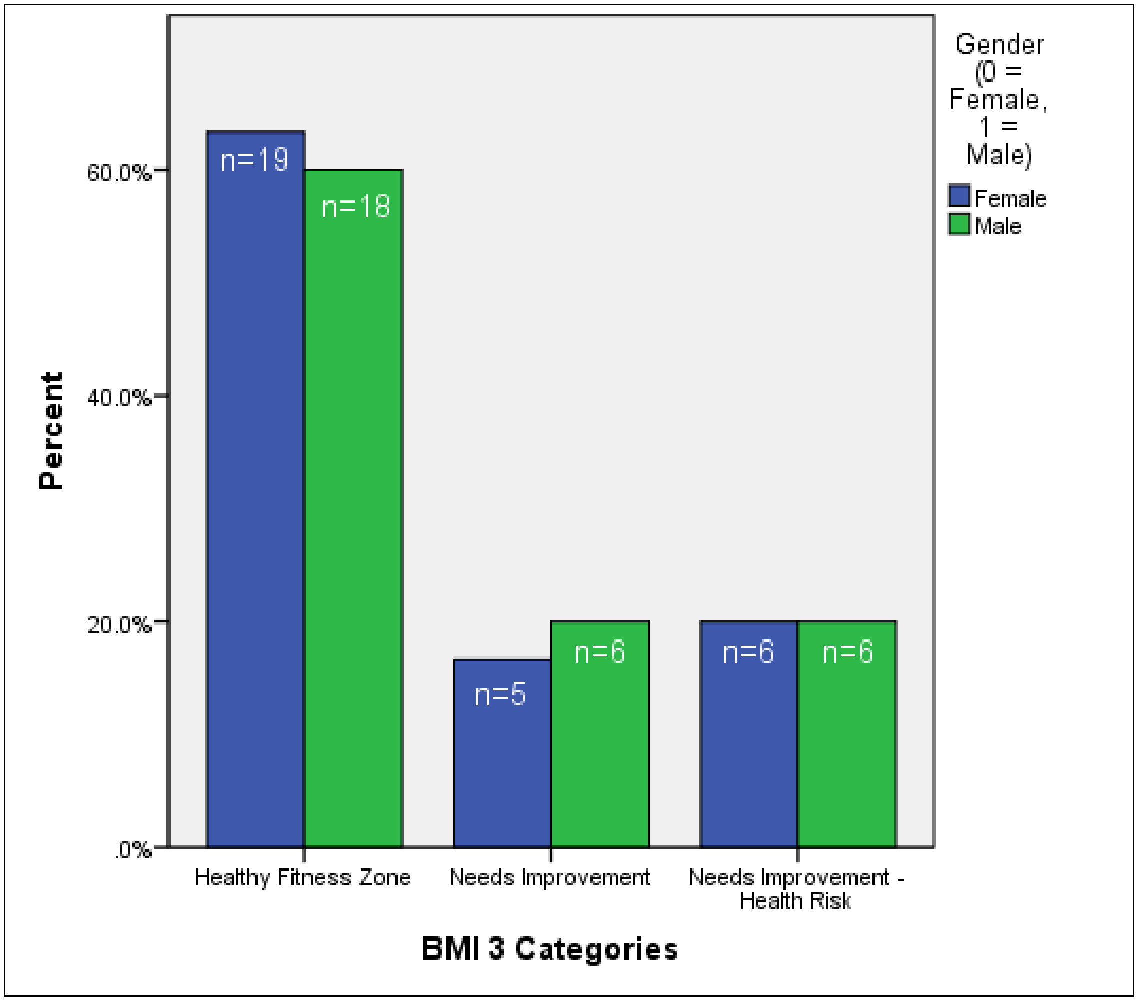


*Figure 2.* Percentage of gender distribution within BMI fitness zones.

(FITNESSGRAM Performance Standards, 2013) (see Table 3). Figure 5 shows the number of students per each group in the cardiovascular fitness testing. Forty-five (45) subjects (75%) were not in the Healthy Fitness Zone, and 15 subjects (25%) were. Figure 6, shows the distribution of percentages of male and females in each group, while Figures 7 and 8 represent ethnicities and age respectively.

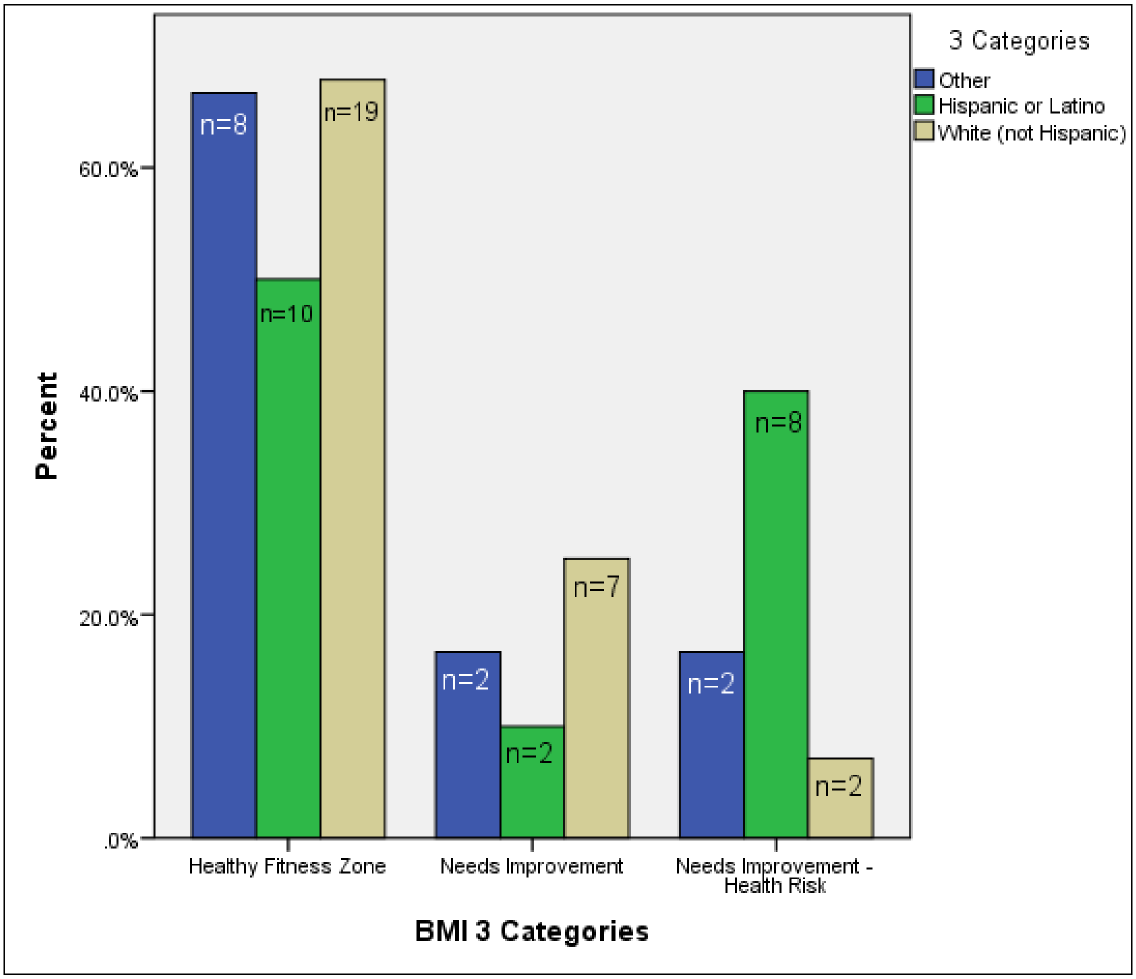


*Figure 3.* Percentage of ethnicity distribution within BMI fitness zones.

Health Related Fitness Knowledge

For the third and final data collection test, subjects completed the Physical Education Cognitive Assessment (SCPEAP, 2007). The test was completed in their classroom during their normal physical education class. Subjects completed the assessment in the allotted time (20 minutes) and were able to ask questions during the assessment. The subjects were asked to "answer the questions to the best of your ability." The assessment consisted of 50% fill in the blank (10 questions), and 50% multiple-choice (10 questions). Figure 9 displays the distribution of results among the subjects

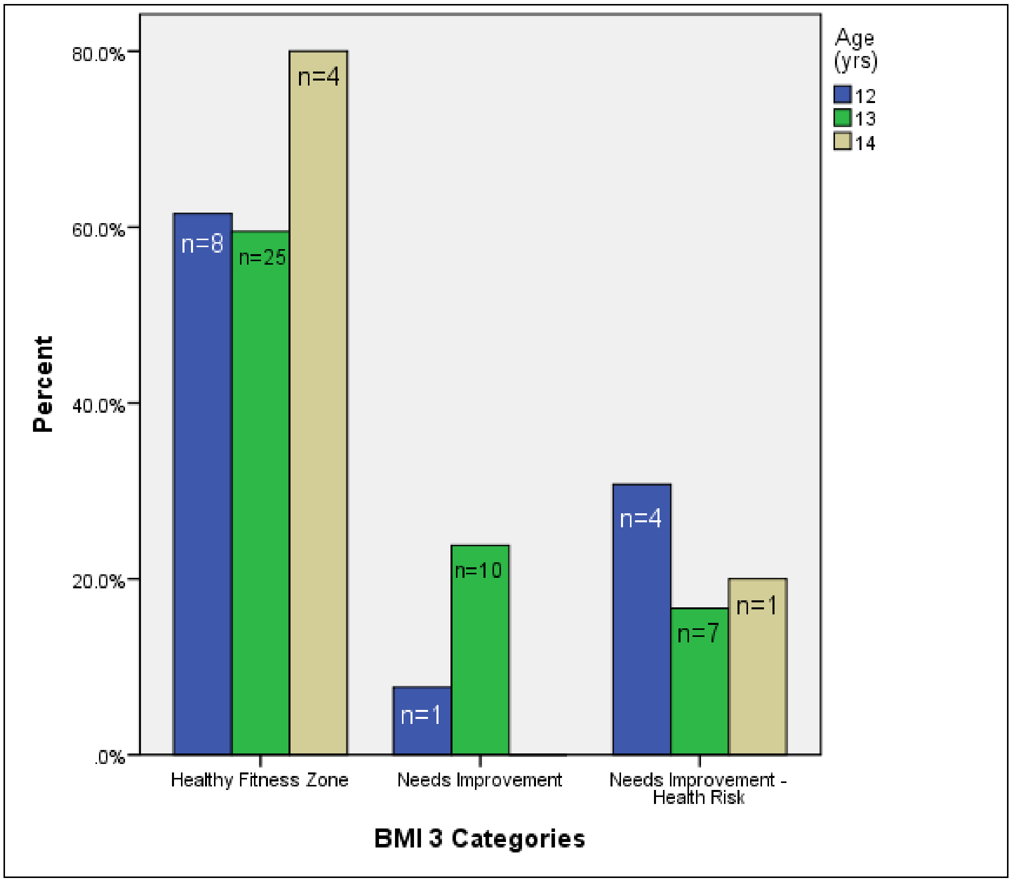


*Figure 4.* Percentage of age distribution within BMI fitness zones.

Table 3

*Cardiovascular Fitness Zone cut off scores (FITNESSGRAM Performance Standards, 2013)*

| | PACER (15m) | |
|---|---|---|
| Age | Male | Female |
| 10 | 21 | 21 |
| 11 | 25 | 25 |
| 12 | 31 | 30 |
| 13 | 38 | 32 |
| 14 | 47 | 35 |
| 15 | 55 | 39 |

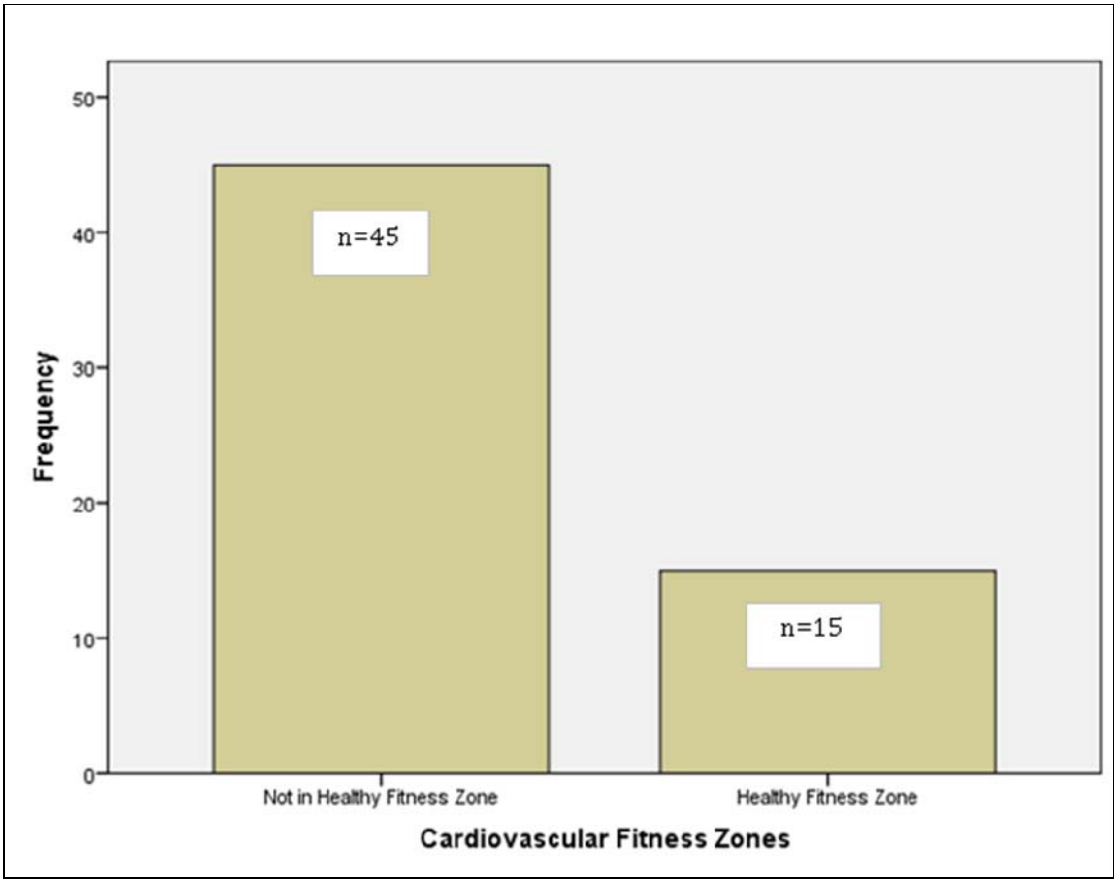


*Figure 5.* Frequency of cardiovascular fitness zones.

showing an even distribution. Furthermore, Table 4 represents the distribution of results among gender, ethnicity, and age.

Relationship Between Health-Related Fitness Knowledge and BMI

To further analyze the findings, the non-parametric, Kruskal-Wallis test was used to determine the relationship between health-related fitness knowledge and BMI. Results can be seen on Table 5, and with chi-square (2,N=60) = 0.892, $p = 0.64$, there was no significant difference between the three BMI categories in regards to the fitness knowledge assessment results.

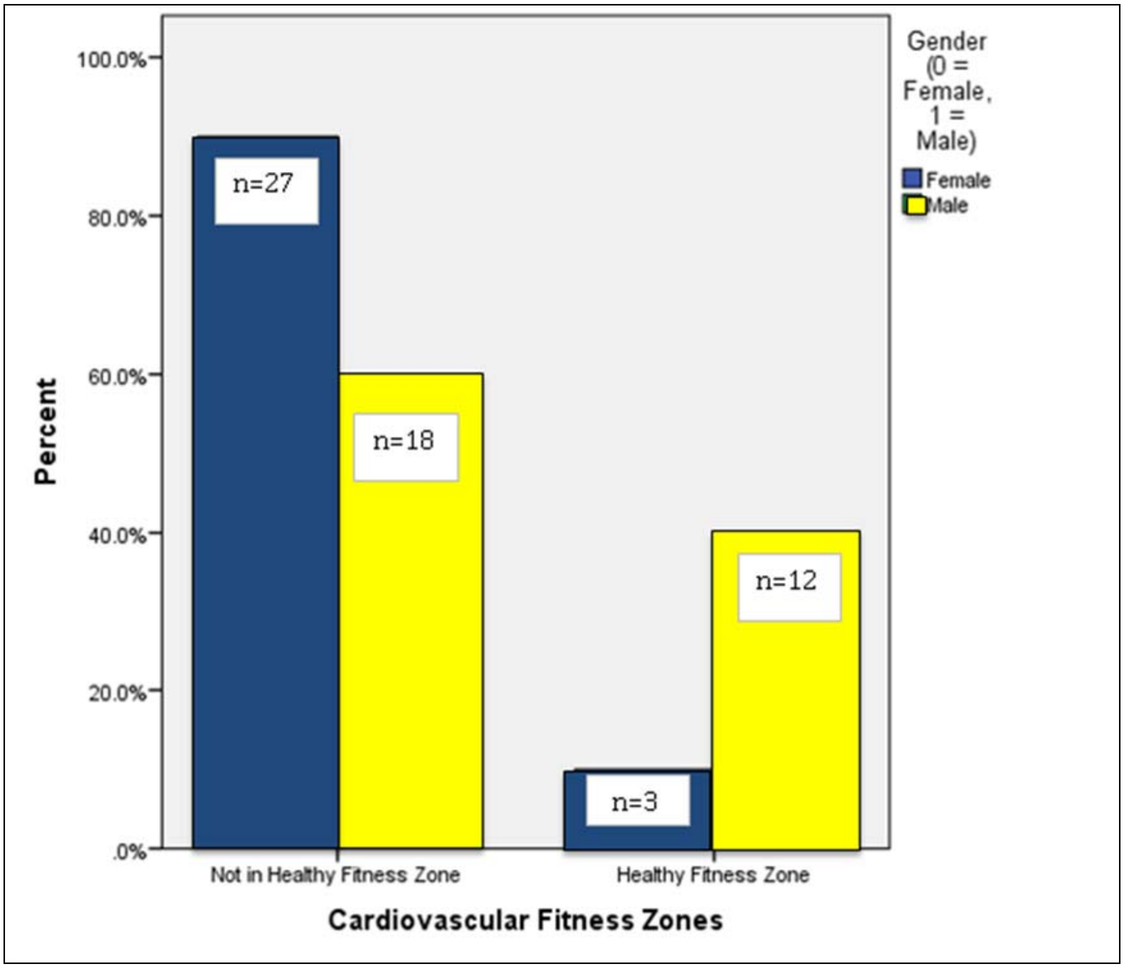


*Figure 6.* Percentage of gender distribution within cardiovascular fitness zones.

Relationship Between Health-Related Fitness Knowledge and Cardiovascular Fitness

An additional non-parametric test was used to determine the relationship between health related fitness knowledge and cardiovascular fitness. The Mann-Whitney U test also showed no significant relationship between the two variables ($z$ = -1.207, $p$ = 0.227) (see Table 6). This concludes there is no significant difference with respect to health-related fitness knowledge between the two cardiovascular fitness zones (Healthy Fitness Zone and not in Healthy Fitness Zone).

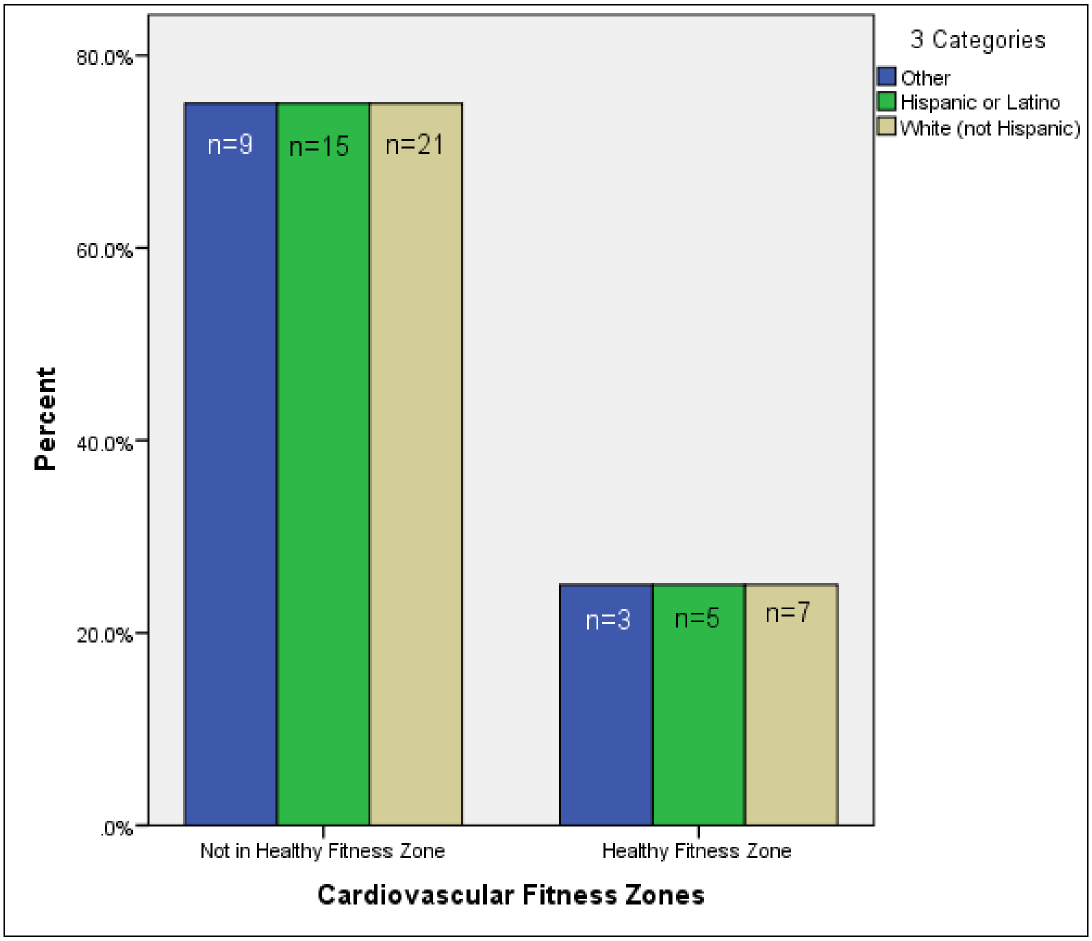


*Figure 7.* Percentage of ethnicity distribution within cardiovascular fitness zones.

Affects of Ethnicity, Age, and Gender

Further analysis was completed to determine differences regarding ethnicity, age, and gender. The Kruskal-Wallis Test showed no significant differences between ethnicities in regards to BMI, cardiovascular fitness, or health-related fitness knowledge (see Table 7) with chi-square (2,N=60) = 0.731 and $p$ = 0.69. Similarly a Mann-Whitney U test calculated $z$ = -0.615, $p$ = 0.538, which revealed no significant difference between gender in regards to BMI, cardiovascular fitness, or health-related fitness knowledge (Table 8), and an additional Kruskal-Wallis test revealed no significant differences

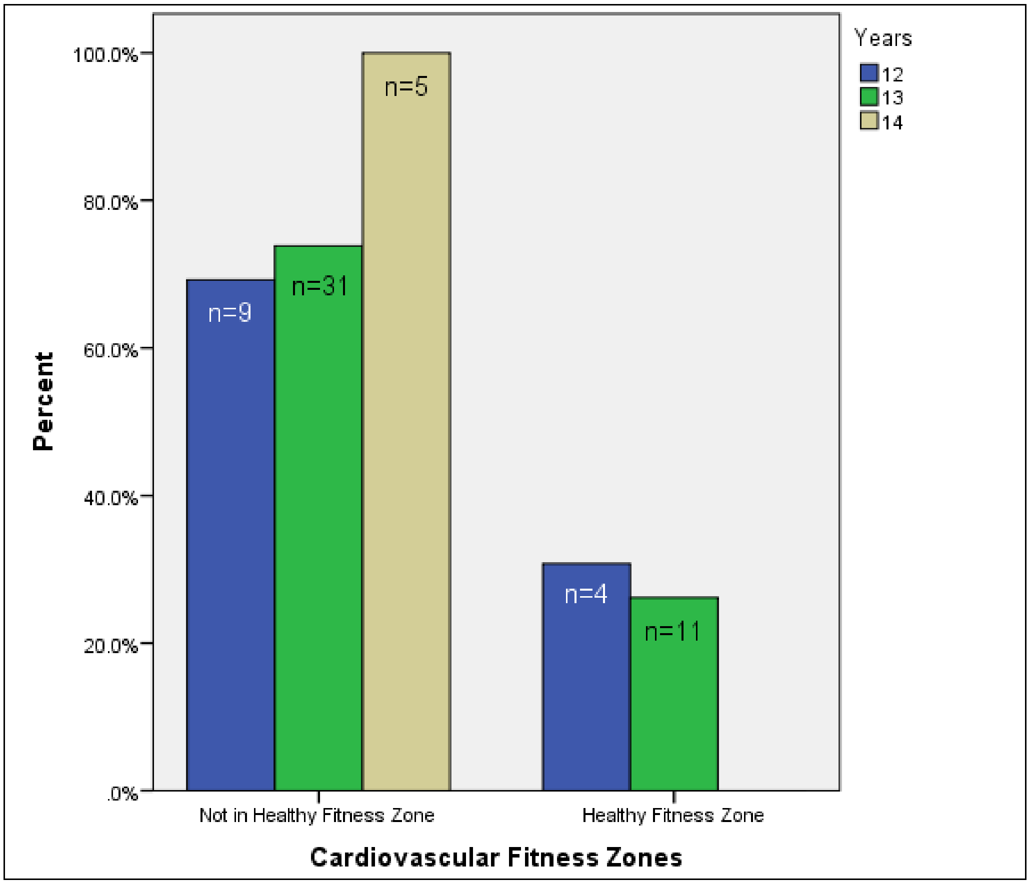


*Figure 8.* Percentage of age distribution within cardiovascular fitness zones.

between ages in regards to BMI, cardiovascular fitness, and health-related fitness knowledge, with chi-square (2,N=60) = 0.1.774 and $p =$ 0.412 (Table 9).

Additional Analysis

In addition to answering the research questions, the data between BMI and cardiovascular fitness were further analyzed. Initially a Mann-Whitney U test showed a significant difference between the two variables with $z$ =-2.452, $p$ = 0.014 (see Table 10). The analysis was run an additional time excluding the outliers, which included any participants who's BMI fell outside the top 25% of BMI scores and the P value was again significant at $z$ =-2.882, $p$ = 0.004 (see Table 11).

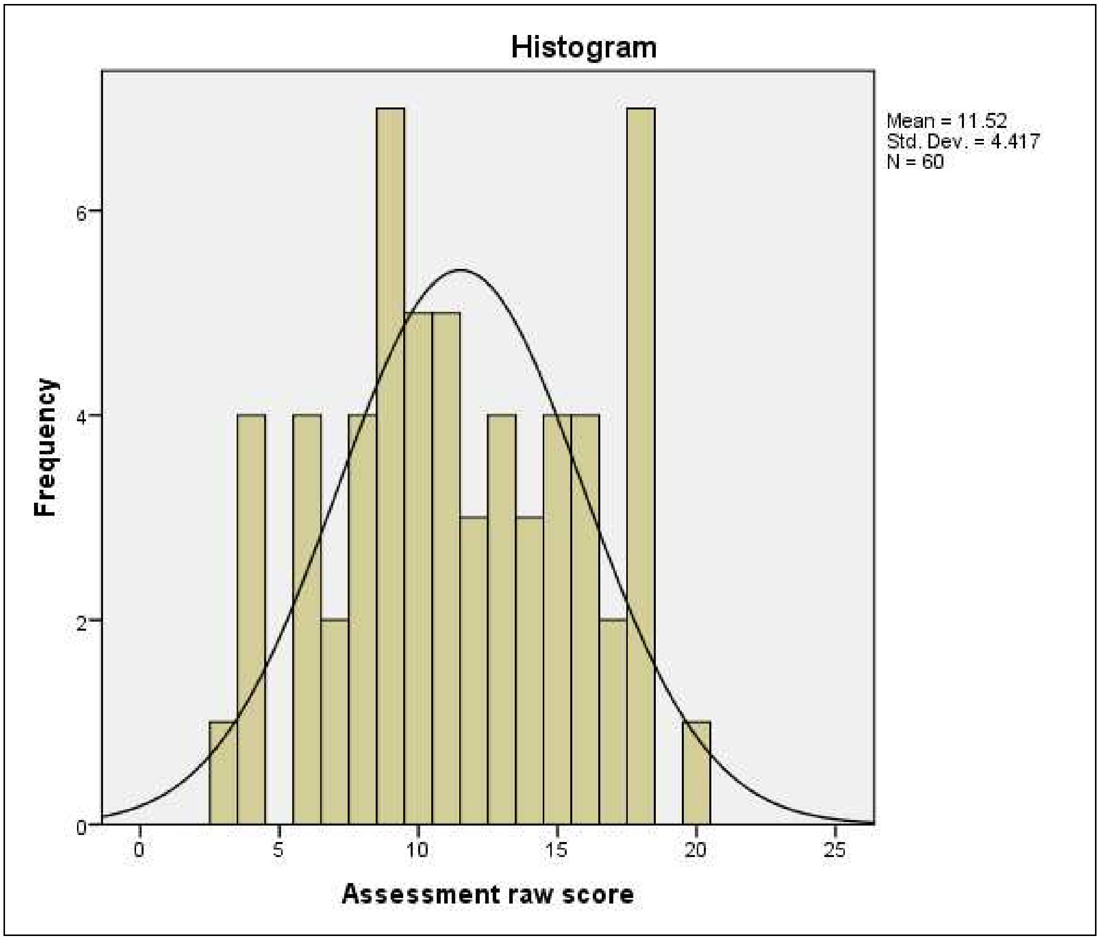


*Figure 9.* Distribution of health-related fitness knowledge assessment.

## Discussion

This discussion explains, in detail, the results of the relationship between BMI, cardiovascular fitness, and health-related fitness knowledge in adolescents. The sources of data in this study include height and weight, used for calculating BMI, the PACER test used to determine cardiovascular fitness, and a Physical Education Cognitive Assessment (SCPEAP, 2007), which assessed their health-related fitness knowledge.

Due to the increasingly high prevalence of childhood obesity (Phillips, 2012), studies that further explore the public health dilemma are important to help researchers

Table 4

*Descriptive Health-Related Fitness Knowledge Results*

| | *n* | Mean | ±S.D. |
|---|---|---|---|
| Gender | 30 | 11.80 | 0.85 |
| Females | 30 | 11.23 | 0.77 |
| Males | | | |
| Age | | | |
| 12 | 13 | 12.15 | 1.06 |
| 13 | 42 | 11.55 | 0.72 |
| 14 | 5 | 9.60 | 1.63 |
| Ethnicity | | | |
| White (not Hispanic) | 28 | 11.46 | 0.89 |
| Hispanic or Latino | 20 | 11.05 | 0.82 |
| Other | 12 | 12.42 | 1.47 |

Table 5

*Relationship Between Health-Related Fitness Knowledge and BMI*

Ranks

| | BMI 3 Cat | *N* | Mean Rank |
|---|---|---|---|
| Raw Score | Healthy Fitness Zone | 37 | 30.04 |
| | Needs Improvement | 11 | 34.68 |
| | Needs Improvement - Health Risk | 12 | 28.08 |
| | Total | 60 | |

Test Statistics[a,b]

| | Raw Score |
|---|---|
| Chi-Square | .892 |
| *df* | 2 |
| Asymp. Sig. | .640 |

a. Kruskal Wallis Test

b. Grouping Variable: BMI 3 Cat

Table 6

*Relationship Between Health-Related Fitness Knowledge and Cardiovascular Fitness*

Ranks

| | 2 Cat | *N* | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| Raw Score | Not in Healthy Fitness Zone | 45 | 32.07 | 1443.00 |
| | Healthy Fitness Zone | 15 | 25.80 | 387.00 |
| | Total | 60 | | |

Test Statistics[a]

| | Raw Score |
|---|---|
| Mann-Whitney U | 267.000 |
| Wilcoxon W | 387.000 |
| *Z* | -1.207 |
| Asymp. Sig. (2-tailed) | .227 |

a. Grouping Variable: 2 Cat

understand why these trends are occurring. Results of this study indicated similar rates of obesity as existing studies (International Obesity Taskforce, 2013; Strauss & Pollack, 2001) with 38.3% of subjects categorized as the Needs Improvement or the Needs

Table 7

*Relationship Between Ethnicity & BMI, Cardiovascular Fitness, and Health-Related Fitness Knowledge*

Test Statistics[a,b]

| | BMI 3 Cat | 2 Cat | Raw Score |
|---|---|---|---|
| Chi-Square | 3.474 | .000 | .731 |
| *df* | 2 | 2 | 2 |
| Asymp. Sig. | .176 | 1.000 | .694 |

a. Kruskal Wallis Test

b. Grouping Variable: 3 categories

Table 8

*Relationship Between Gender & BMI, Cardiovascular Fitness, and Health-Related Fitness Knowledge*

| Test Statistics[a] | | | |
|---|---|---|---|
| | BMI 3 Cat | 2 Cat | Raw Score |
| Mann-Whitney U | 438.000 | 315.000 | 408.500 |
| Wilcoxon W | 903.000 | 780.000 | 873.500 |
| *Z* | -.205 | -2.661 | -.615 |
| Asymp. Sig. (2-tailed) | .838 | .008 | .538 |

a. Grouping Variable: Gender (0 = Female, 1 = Male)

Improvement – Health Risk BMI categories. Twenty percent (20%) of the subjects were categorized as Needs Improvement – Health Risk, which is only minimally higher then that of the CDC's (2013) prevalence of obesity, which state that approximately 17% of children and adolescents, are obese. This study also found no significant differences in BMI distribution between gender, ethnicity, or age.

There have been several previous studies that have examined the affects of culture on physical fitness levels. The results of this study did not reveal a significant

Table 9

*Relationship Between Age & BMI, Cardiovascular Fitness, and Health-Related Fitness Knowledge*

| Test Statistics[a,B] | | | |
|---|---|---|---|
| | BMI 3 Cat | 2 Cat | Raw Score |
| Chi-Square | .517 | 1.897 | 1.774 |
| *df* | 2 | 2 | 2 |
| Asymp. Sig. | .772 | .387 | .412 |

a. Kruskal Wallis Test

b. Grouping Variable: Years

Table 10

*Relationship Between BMI and Cardiovascular Fitness*

| Test Statistics[a] | |
| --- | --- |
| | BMI 3 Cat |
| Mann-Whitney U | 213.000 |
| Wilcoxon W | 333.000 |
| *Z* | -2.452 |
| Asymp. Sig. (2-tailed) | .014 |

a. Grouping Variable: 2 Cat

difference between the ethnic groups in either BMI or cardiovascular fitness. These results oppose similar research that states that the prevalence of overweight and obesity is elevated among minority groups (Luder et al., 1998). Luder et al., also found the BMI in Hispanic children to be higher then the national average (1998). These discrepancies may be due to the low number of participants in each ethnic group. Additionally, in this study no differences were found between gender and BMI or cardiovascular fitness or age and BMI and cardiovascular fitness.

Table 11

*Relationship Between BMI and Cardiovascular Fitness Minus Outliers*

| Test Statistics[a] | |
| --- | --- |
| | BMI score |
| Mann-Whitney U | 156.000 |
| Wilcoxon W | 276.000 |
| *Z* | -2.882 |
| Asymp. Sig. (2-tailed) | .004 |

a. Grouping Variable: 2 Cat

There are two main factors that can affect obesity: nutrition and physical activity. Nutrition was not examined in this study and although the researchers did not directly measure physical activity, an aspect of physical fitness was measured, and the two are found to coincide (Cooper, 2010). Cardiovascular fitness was measured using a PACER test, a widely accepted means for measuring cardiovascular fitness (Mahoney, 1992). The results indicate that only 25% of the subjects were categorized in the Healthy Fitness Zone for the cardiovascular fitness. That leaves 75%, or 45 subjects, out of the Healthy Fitness Zone. These results are similar to the percentages that Cooper (2010) reported of Jr. High aged subjects who achieved a Healthy Fitness Zone on not only cardiovascular fitness but on all six FITNESSGRAM ® tests. For seventh grade students the percentage of students who achieved Healthy Fitness Zone ™ on all six FITNESSGRAM® tests averaged 25.5% for girls and 19.7% for boys.

Upon examination of the analysis between cardiovascular fitness and BMI, a significant difference was found between the two variables. To account for outliers, participants that fell outside the top 25% of BMI scores were excluded from the data set and the variables were reanalyzed. A significant difference was found again between the BMI and cardiovascular fitness. These results were expected, for it is widely accepted that as BMI increases in an individual, oxygen consumption, or cardiovascular fitness, decrease (Rowland, 1991). These results were similar to many studies that examine comparisons between weight status and fitness levels (He et al., 2011; Leyk et al., 2012; Mak et al., 2010; Pate et al, 2006; Rowland, 1991). Similarly, many of these studies (He et al., 2011; Pate et al., 2006) also found the gender played no role in the relationship between BMI and cardiovascular fitness.

The analysis of health-related fitness knowledge showed an even distribution of scores across the graph. Scores were similar across gender, age, and ethnicity, and no significant difference was found between any of these variables. Ultimately, this study showed no significant relationship between BMI and health-related fitness knowledge. Additionally, no significant relationship was found between cardiovascular fitness and health-related fitness knowledge. There may have been no significant differences found due to the context of the school's physical education curriculum. The physical education curriculum was activity based and fitness knowledge was not an emphasis. This could have led to the low health-related fitness knowledge scores found in this study. These results coincided with Sullivan (2006) who also found no relationship between BMI and health-related fitness knowledge in her study of 5th grade students. The lack of relationship between BMI and cardiovascular fitness also corresponds with the findings of other researchers who found no significant correlation between health-related fitness knowledge and physical activity in middle school students (Ferguson et al., 1989). However, these results contradict research that did find a significant correlation between health-related fitness knowledge and physical activity in 5th and 6th grade students (Dilorenzo et al., 1998). More studies need to be done to further analyze this relationship.

# CHAPTER V

# SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter is divided into three main sections. The first section summarizes the research and results found in this study. The second section reviews the conclusions in reference to the research questions. The third, and final section, will further explain the need and recommendations for future research in the field of childhood obesity.

## Summary

Due to the high prevalence of childhood obesity, it is important to understand the factors that may affect this urgent public health concern. This study sought to add understanding by examining the relationships between different aspects of health, fitness, and health-related knowledge. The purpose of this study was to examine the relationship between Body Mass Index (BMI), cardiovascular fitness, and health-related fitness knowledge in diverse, low-income, Jr. High School students. The study took place in a small town in the northern valley of California. Participants consisted of 7$^{th}$ grade students, from a single school, who returned parental consent forms. Data collection included four techniques including height and weight measured to calculate BMI, a PACER test used to measure cardiovascular fitness, the Physical Education Cognitive

Assessment (SCPEAP, 2007) used to assess health-related fitness knowledge, and demographics, including gender, birthday, and ethnicity.

Out of 138 7th grade students attending the school at the time of data collection, 60 participants (30 males, 30 females) returned parental consent forms. The sample included 46.7% white (not Hispanic), 33.3% Hispanic, and 20% other ethnicities. Participants were all between the ages of 12-14 years old, with the average age being 12.9 years.

Results of height and weight calculation consisted of 61.7% of participants who were categorized in the Healthy Fitness Zone in regards to BMI, whereas 18.3% were categorized into the Needs Improvement zone, and 20% were categorized into the Needs Improvement – Health Risk zone. Cardiovascular fitness, as measured by the PACER, resulted in 25% of participants measuring in the Healthy Fitness Zone, and 75% of the students measuring out of the Healthy Fitness Zone; meaning they did not complete the number of laps needed to be considered fit from a cardiovascular standpoint. The required number of laps needed, was dependent of both age and gender. Results from the Physical Education Cognitive Assessment (SCPEAP, 2007), measuring health-related fitness knowledge, had a mean score of 11.52 and a standard deviation of 4.42.

A significant difference was found when examining the relationship of BMI and cardiovascular fitness. This relationship remained significant after the outliers were excluded from the analysis. The outliers were defined as any participants who fell outside of the top 25% of the BMI scores. There was no significant difference found however between BMI and health-related fitness knowledge, or cardiovascular fitness and health-related fitness knowledge. The results also showed no significant differences between age, gender, or ethnicity in regards to BMI, cardiovascular fitness, or health-related fitness knowledge.

This study found a significant difference between BMI and cardiovascular fitness and insignificant differences between the other variables present in this study. These data are specific to the Jr. High School, and students who participated in this study. It is important to remember this study was specific to both location and participants when interpreting the results.

## Conclusions

The following conclusions regard Jr. High aged students and the relationship between BMI, cardiovascular fitness, and health-related fitness knowledge.

1. No significant relationship was found between BMI or cardiovascular fitness, and health-related fitness knowledge. Therefore, adolescents with high BMI and low cardiovascular fitness do not necessarily have low health-related fitness knowledge.

2. Similarly, adolescents with low BMI and high cardiovascular fitness do not necessarily have high health-related fitness knowledge.

3. Ethnicity, age, and gender, appear to have no affect on BMI, cardiovascular fitness, or health-related fitness knowledge. They also have no effect on the relationships between these variables.

## Recommendations for Future Research

The need for further research in the area of childhood obesity is imperative. We must seek to understand this problem to not only stop the increasing rates of obesity but also do whatever possible to reverse this detrimental trend. Studies involving a larger and more diverse sample size would be useful in making inferences about children and/or adolescents in general. This study involved only the results of one rural, low income, Jr. High school and one must remember that when interpreting the results.

Future research should involve adolescents from all different cultures and backgrounds. Although this study did have a diverse sample, between Hispanic and white (not Hispanic), greater diversity would be helpful in interpreting results to all adolescents, and not just specific ethnicities. Age and grade are also areas where future studies can be more inclusive. Being that this study only had 7$^{th}$ graders, their age did not have much variation. Adolescents are constantly changing how they think and feel, and there is no guarantee that how one teaches the importance of health to a 10 year old, would be the same as a 15 year old. It is important to understand a wide range of ages if researchers, parents, health education, doctors, etc. are trying to inform children or adolescents about the negative consequences of obesity.

Upon assessing physical fitness, this study only measured cardiovascular fitness. Instead of just focusing on one measurement of physical fitness, future studies may find it valuable to focus on several measurements. There can be many benefits to this in terms of understanding health. Although cardiovascular fitness is notably important, it is not the only way to be “fit” and other aspects of fitness (strength, flexibility, etc.) are also important and should be considered when determining physical fitness levels.

There are other aspects of health-related fitness knowledge that would be valuable if assessed in future research. For example, although this study assessed the subject's knowledge with a validated Physical Education Cognitive Assessment, there is still more to learn about the adolescent's knowledge levels. In addition to assessing what the participants do and do not know, researchers should also focus on what they would like to know, or what they find interesting with respect to health and health practices. One way to discover this information could be through open discussions or focus group interviews. If health professionals can better understand what is interesting or important to adolescents, one might find it easier to connect with them and help them to reach specific fitness goals.

One of the biggest hindrances in measuring levels of physical fitness and health-related fitness knowledge is the ability to control for the motivation put forth from the participants. If researchers have the ability to include incentives or find ways to provide motivation for the participants to put forth their best effort, it would greatly benefit the validity of the study. Knowing the participants are putting forth their best fitness or knowledge level, relationships found between variables are more likely to reflect actual significance.

The relationship between BMI and cardiovascular fitness shows that when adolescents are fit on a cardiovascular level, their body composition is more likely to fall within a healthy BMI range, based off of their gender and age. The lack of relationship between BMI, or cardiovascular fitness, and health-related fitness knowledge conclude that regardless of the amount of knowledge one has about health and fitness, it may not accurately predict their fitness level or body composition. Based on the results of this study, the researcher believes that when teaching adolescents about fitness, it is likely more effective to teach them ways to be healthy verses teaching them the importance of doing so.

The research community would greatly benefit from further research regarding the relationship between health status and health-related fitness knowledge in children and youth. The more health professionals can understand, the better, and there are many types of studies that can help lead to a further and deeper understanding of all aspects relating to childhood obesity. It is this knowledge that will shape our tomorrow and affect the future behaviors of health and fitness in children and adolescents.

# REFERENCES

# REFERENCES

American Obesity Treatment Association. (2013). *Childhood obesity*. Retrieved from http://www.americanobesity.org/childhoodObesity.htm

Ara, I., Moreno, L. A., Leiva, M. T., Gutin, B., & Casajús A. (2007). Adiposity, physical activity, and physical fitness among children from Aragón. *Obesity, 15,* 1918-1924.

Beets, M. W., Pitetti, K. H., & Forlaw, L. (2007). The role of self-efficacy and referent specific social support in promoting rural adolescent girls' physical activity. *American Journal of Health Behavior, 31*(3), 227-37.

Boyse, W. (2004). Young people in Canada: Their health and well-being. Retrieved from http://www.phac-aspc.gc.ca/dca-dea/publications/hbsc-2004/hbsc_summary_e.htm.

Brockman, R., Jago, R., & Fox, K. R. (2011). Children's active play: Self-reported motivators, barriers and facilitators. *BMC Public Health, 11*(461) Retrieved from http://www.biomedcentral.com/1471-2458/11/461.

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. *Public Health Reports, 100*(2), 126-131.

Centers for Disease Control and Prevention. (2011). *About BMI for children and teens*. Retrieved from http://www.cdc/gov/healthyweight/assessing/bmi/childrens_BMI/about_childr en s_BMI.html

Centers for Disease Control and Prevention. (2013). *Childhood overweight and obesity*. Retrieved from http://www.cdc.gov/obesity/childhood/index.html.

City-Data. (2012). *Palermo, California*. Retrieved from http://www.city-data.com/city/Palermo-California.html.

Cooper, K. H. (2010). Reflections on the Texas youth evaluation project and implications for the future. *Research Quarterly for Exercise and Sport, 81*(3), S79-S83.

Daniels, S. D. (2006). The consequences of childhood overweight and obesity. *The Future of Children, 16*(1), 47-67.

Deforche, B., Lefevre, J., De Bourdeaudhuij, I., Hills, A. P., Duquet, W., & Bouckaert, J. (2003). Physical fitness and physical activity in obese and nonobese Flemish youth. *Obesity Research, 11*(3) 434-441.

Department of Education. (2013). *Physical education/activity: Definitions*. Retrieved from http://www.tn.gov/education/schoolhealth/physed/definitions.shtml.

Dietz, W. H. (1994). Critical periods in childhood for the development of obesity. *American Journal of Clinical Nutrition, 59,* 955-959.

Dilorenzo, T. M., Stucky-Ropp, R. C., Vander Wal, J. S., & Gotham, H. J. (1998). Determinants of exercise among children: A longitudinal analysis. *Preventive Medicine, 27*(3), 470- 477.

Duke, J., Huhman, M., & Heitzler, C. (2003). Physical activity levels among children aged 9- 13 years – United States, 2002. *Morbidity and Mortality Weekly Report, 52*(33), 785-788.

Duncan, S. C., Duncan, T. E., Strycker, L. A., & Chaumeton, N. R. (2007). A cohort-sequential latent growth model of physical activity from ages 12-17 years. *Annals of Behavioral Medicine, 33,* 80-89.

Edwardson, C. L. & Gorely, T. (2010). Parental influences on different types and intensities of physical activity in youth: A systematic review. *Psychology of Sport and Exercise, 11*, 522-535.

Faulkner, S. M. (2010). Cardiovascular fitness and quality of life in adolescents with type 1 or type 2 diabetes. *Journal for Specialists in Pediatric Nursing, 15*(4), 307-316.

Ferguson, K. J., Yesalis, C. E., Pomrehn, P. R., & Kirkpatrick, M. B. (1989). Attitudes, knowledge, and beliefs as predictors of exercise intent and behavior in schoolchildren. *The Journal of School Health, 59,* 112-115.

FITNESSGRAM Performance Standards. (2013). *2013-2014 physical fitness test (PFT)*. Retrieved from http://www.cde.ca.gov/ta/tg/pf/documents/pft1314pfscharts.pdf

Fitzgerald, A., Fitzgerald, N. & Aherne, C. (2012). Do peers matter? A review of peer and/or friends' influence on physical activity among American adolescents. *Journal of Adolescence, 35,* 941-958.

Fitzgerald, J. T., Singleton, S. P., Neale, A. V., Prasad, A. S., & Hess, J. W. (1994). Activity levels, fitness status, exercise knowledge, and exercise beliefs among healthy, older African American and white women. *Journal of Aging and Health, 6,* 296-313.

Gray, W. N., Janicke, D. M., Ingerski, L. M., & Silverstein, J. H. (2008). The impact of peer victimization, parent distress and child depression on barrier formation and physical activity in overweight youth. *Journal of Developmental & Pediatrics, 29,* 26- 33.

Hallal, P. C., Victora, C. G., Azevedo, M. R., & Wells, J. C. (2006). Adolescent physical activity and health: A systematic review. *Sports Medicine, 36*(12), 1019-1030.

Hardman, K. (2008). Physical education in schools: A global perspective. *Kinesiology, 40*(1), 5-28.

He, Q., Wong, T., Du, L., Jiang, Z., Yu, T. I., Hong, Q…. & Wu, J. (2011). Physical activity, cardiorespiratory fitness, and obesity among Chinese children. *Preventive Medicine, 52*, 109-113.

Himes, J. H. (2009). Challenges of accurately measuring and using BMI and other indicators of obesity in children. *Pediatrics*, *124*(1), S3-22.

Hyndman, B., Telford, A., Finch, C. F., & Benson, A. C. (2012). Moving physical activity beyond the school classroom: A social-ecological insight for teachers of the facilitators and barriers to student' non-curricular physical activity. *Australian Journal of Teacher Education*, *37*(2), article 1.

International Obesity Taskforce. (2013). *The global epidemic*. Retrieved February 8th, 2013, from http://www.iaso.org/iotf/obesity/obesitytheglobalepidemic/

Johnson, W. Soloway, L. E., Erickson, D., Choh, A. C., Lee, M., Chumlea, W. C…. & Demerath, E. W. (2012). A changing pattern of childhood BMI growth during the 20th century: 20 y of data from the Fels Longitudinal Study. *American Journal of Clinical Nutrition, 95,* 1136-1143.

Keating, X. D., & Silverman, S. (2004). Teachers' use of fitness tests in school-based physical education programs. *Measurement in Physical Education and Exercise Science, 8*, 145- 165.

Keating, X. D., Harrison, L., Chen, L., Xiang, P., Lambdin, D., Dauenhauer, B…. & Piñero, J. C. (2009). An analysis of research on student health-related fitness knowledge physical education programs. *Journal of Teaching in Physical Education, 28,* 333-349.

Klein, S., Burke, L. E., Bray, G. A., Blair, S., Allison, D. B., Xavier P.,… Eckel, R. H. (2004). Clinical implications of obesity with specific focus on cardiovascular disease. *Circulation, 110,* 2952-2967.

Kopelman, P. G. (2000). Obesity as a medical problem. *Nature, 404*(6778), 635-643.

Kraus, H., & Hirschland, R. P. (1954). Minimum muscular fitness tests in school children. *Research Quarterly, 25,* 178–188.

Leyk, D., Ruther, T., Witzki, A., Sievert, A., Moedl, A., Blettner, M…. & Lollgen, H. (2012). Physical fitness, weight, smoking, and exercise patterns in young adults. *Deutsches Arzteblatt International, 109*(44), 737-745.

Lohman, T. G. (1992). *Advances in body composition*. Champaign, IL: Human Kinetics.

Lowry, R., Wechsler, H., Kann, L., & Collins, J. L. (2001). Recent trends in participation in physical education among US high school students. *Journal of School Health, 71*(4), 407-412.

Luder, E., Melnik, T. A., DiMaio, M. (1998). Association of being overweight with greater asthma symptoms in inner-city Black and Hispanic children. *Journal of Pediatrics, 132,* 699-703.

Mahoney, C. (1992). 20-MST and PWC170 in non-Caucasian children in the UK. *British Journal of Sports Medicine, 26*(1), 45-47.

Mak, K. Ho, S., Lo, W. Thomas, G. N., McManus, A. M., Jeffrey R. D., & Lam, T. (2010). Health- related physical fitness and weight status in Hong Kong adolescents. *BMC Public Health, 10*(88), 1-6.

Martin, S. B., Rhea, D. J., Greenleaf, C. A., Judd, D. E., & Chambliss, H. O. (2011). Weight control beliefs, body shape attitudes, and physical activity among adolescents. *Journal of School Health, 81*(5), 244-250.

Matsuzaka, A., Takahashi, Y., Yamazoe, M., Kumakura, N., Ikeda, A., Wilk, B., & Bar-Or, O. (2004). Validity of the multistage 20-m shuttle-run test for Japanese children, adolescents, and adults. *Pediatric Exercise Science, 16*(2), 113-125.

McArdle, W. D., Katch F. I., & Katch, V. L. (1986). *Exercise physiology: Energy, nutrition, and human performance* (2nd ed.). Philadelphia, PA: Lea & Febiger.

Mendelson, R. (2007). Think tank on school-aged children: Nutrition and physical activity to prevent the rise in obesity. *Applied Physiology of Nutrition Metabolism, 32*, 495- 499.

Meredith, M. D., & Welk, G. J. (2010). FitnessGram & ActivityGram test administration manual (updated 4th edition). Champaign, IL: Human Kinetics.

Mooney, B. (2012). Childhood obesity: Time to wake up to the facts. *WIN, 20*(7), 41-42.

Morgan, C. F., Beighle, A., & Pangrazi, R. P. (2007). Physical education's contribution to daily physical activity levels of elementary school children. *Research Quarterly for Exercise & Sport, 78*(5), 407-412.

Mori M., Higuchi, K. Sakurai, A., Tabara, Y. Miki, T. & Nose, H. (2009). Genetic basis of inter- individual variability in the effects of exercise on the alleviation of lifestyle-related diseases. *Journal of Physiology, 587*(23), 5577-5584.

Moreir, C., Santos, R., de Farias, J. C., Vale, S., Santos, P. C., Soares-Miranda, L. &… Mota, J. (2001). Metabolic risk factors, physical activity and physical fitness in azorean adolescents: a cross-sectional study. *BMC Public Health, 11,* 214.

Morrow, Jr, J.R. (2005). Are American children and youth fit? It's time we learned. *Research Quarterly for Exercise and Sport, 76*(4), 377-388.

Morrow, Jr. J.R., Fulton, J. E., Brener, N. D., & Kohl III, H. W. (2008). Prevalence and correlates of physical fitness testing in U.S. schools-2000. *Research Quarterly for Exercise and Sport, 79*(2), 141-148.

Morrow, Jr., J. R., Martin, S. B., Welk, G. J., Zhu, W., & Meredith, M. D. (2010). Overview of the Texas youth fitness study. *Research Quarterly for Exercise and Sport, 81*(3), S1-S5.

Morrow, Jr., J. R., Martin, S. B., & Jackson, A. W. (2010). Reliability and validity of the FITNESSGRAM®. *Research Quarterly for Exercise and Sport, 81*(3), S24-S30.

Muntner, P., He, J., Cutler, J. A., Wildman, R. P., & Whelton, P. K. (2004). Trends in blood pressure among children and adolescents. *Journal of the American Medical Association, 291*(17), 2107-2113.

Must, A., & Strauss, R. S. (1999). Risks and consequences of childhood and adolescent obesity. *International Journal of Obesity and Related Metabolic Disorders : Journal of International Association for the Study of Obesity*, *23*(2), S2–11.

Mustillo, S., Worthman, C., Erkanli, A., Keeler, G., Angold, A., & Costello, E. J. (2003). Obesity and psychiatric disorder: Developmental trajectories. *Pediatrics*, *111*(4), 851-859.

Nihiser, A. J., Lee, S. M., Wechsler, H., McKenna, M., Odom, E., Reinold, C… Grummer-Strawn, L. (2007). Body mass index measurement in schools. *Journal of School Health, 77*(10), 651-671.

Okamato, E., Davidson, L. L., & Conner, D. R. (1993). High prevalence of overweight in inner-city school children. *American Journal of Diseases of Children, 147,* 155-159.

Ortega, F. B., Ruiz, J. R., Castillo, M. J., & Sjostrom, M. (2008). Physical fitness in childhood and adolescence: A powerful marker of health. *Journal of Obesity, 32,* 1-11.

Pate, R. R. (1988). The evolving definition of physical fitness. *Quest, 40*(3), 174-179.

Pate, R. R., Wang, C. Y., Dowda, M., Farrell, S. W., & O'Neill J. R. (2006). Cardiorespiratory fitness levels among US youth 12-19 years of age: Findings from the 1999-2002 national health and nutrition examination survey. *Archives of Pediatric and Adolescent Medicine, 160*(10), 1005-1012.

Phillips, F. (2012). Facing up to childhood obesity. *Practice Nurse, 42*(11), 14-17.

Pinhas-Hamiel, O. (1996). Increased incidence of non-insulin-dependent diabetes mellitus among adolescents. *Journal of Pediatrics, 128*, 608-615.

Placek, J. H., Griffin, L. L., Dodds, P., Raymond, C., Tremino, F., & James, A. (2001). Middle school student's conceptions of fitness: The long road to a healthy lifestyle. *Journal of Teaching in Physical Education, 20*(4), 314-323.

Prista A., Maia J. A., Damasceno, A., Beunen, G. (2003). Anthropometric indicators of nutritional status: Implications for fitness, activity, and health in school-age children and adolescents from Maputo, Mozambique. *American Journal of Clinical Nutrition, 77*(4), 952-959.

Redfield, R., Linton, R., & Herskovits, M. J. (2009). Memorandum for the study of acculturation. *American Anthropologist, 38*(1), 149-152.

Rodriguez, M. A., Winkleby, M. A., Ahn, D., Sundquist, J., & Kraemer, H. C. (2002). Identification of population subgroups of children and adolescents with high asthma prevalence: Findings from the third national health and nutrition examination survey. *Archives of Pediatric and Adolescent Medicine, 156*, 269-275.

Rowland, T. W. (1991). Effects of obesity on aerobic fitness in adolescent females. *American Journal of Diseases of Children, 145*(7), 757-762.

Sallis, J. F., & Patrick K. (1994). Physical activity guidelines for adolescents: Consensus statement. *Pediatric Exercise Science, 6*(4), 302-314.

School Accountability Report Card (SARC). (2013). *About this school*. Retrieved from http://palermoschools.schoolfusion.us/modules/groups/homepagefiles/cms/2441985/File/SARC/SARC%20Palermo.pdf?sessionid=966af44c7274795f9a6212a4dfe80ecf.

Shriver, L. H., Harrist, A. W., Hubbs-Tait, L., Topham, G., Page, M., & Barrett, A. (2011). Weight status, physical activity, and fitness among third-grade rural children. *Journal of School Health, 81*(9), 536-544.

South Carolina Physical Education Assessment Program. (2007). *Middle school physical education program assessment manual.* Columbia, SC: Author.

Spruijt-Metz, D., Lindquist, C. H., Birch, L. L., Fisher, J. O., & Goran M. I. (2002). Relation between mothers' child-feeding practices and children's adiposity. *American Journal of Clinical Nutrition, 75*, 581-586.

Storch, E. A., Milson, V. A., DeBraganza, N. Lewin, A. B., Geffken, G. R., & Silverstein, J. H. (2007). Peer victimization, psychosocial adjustment, and physical activity in overweight and at-risk-for-overweight youth. *Journal of Pediatric Psychology, 32*(1), 80-89.

Strauss, R. S., & Pollack, H. A. (2001). Epidemic increase in childhood overweight, 1986-1998. *Journal of the American Medical Association, 286,* 2845-2848.

Strong, W. B., Malina, R. M., Blimkie, C. J., Daniels, S. R., Dishman, R. K., Gutin, B… Trudeau, F. (2005). Evidence based physical activity for school-age youth. *Journal of Pediatrics,* 732-737.

Sullivan, A. L. D. (2006). *Relationship between BMI and health-related physical fitness knowledge*. (Unpublished doctoral dissertation). University of Arkansas, Fayetteville.

Trost, S. G., Pate, R. R., Sallis, J. F., Freedson, P. S., Taylor, W. C., Dowda, M., & Sirad, J. (2002). Age and gender differences in objectively measured physical activity in youth. *Medical Science of Sports Exercise, 34*(2), 350-355.

Trudeau, F. (2005). Evidence based physical activity for school-age youth. *Journal of Pediatrics, 146*(6), 732-737.

Thé, B. C. (2006). *Take action! A nurse practitioner practice guide for prevention of childhood obesity* (Master's thesis). Retrieved from http://www.nursing.arizona.edu/library/The_BC.pdf

Trilk, J. L., Pate, R. R., Pfeiffer, K. A., Dowda, M., Addy, C. L., Ridisl, K. M…. Lytle, L. A. (2012). A cluster analysis of physical activity and sedentary behaviors patterns in middle school girls. *Society for Adolescent Health and Medicine, 51,* 292-298.

Troiano, R. P., Berrigan, D., Dodd, K. W., Masse, L. C., Tilert, T., McDowell, M. (2008). Physical activity in the United States measured by accelerometer. *Medical Science of Sport and Exercise, 40*, 181-188.

Troiano, R. P., Flegal, K. M., Kuczmarski, R. J., Campbell, S.M. & Johnson, C. L. (1995). Overweight prevalence and trends for children and adolescents. The National Health and Nutrition Examination Surveys, 1963 to 1991. *Archives of Pediatric & Adolescent Medicine, 149*(10)*,* 1085-1091.

U.S. Department of Health & Human Services. (2013). What is adolescence? Retrieved from http://www.hhs.gov/opa/familylife/tech_assistance/etraining/adolescent_brain/O verview/what_is_adolescence/index/html

Vicente-Rodriguez, G., Urzanqui, A., Mesana, M. I., Ortega, F. B., Ruiz, J. R., Ezquerra, J… Moreno, L. A. (2008). Physical fitness effect on bone mass is mediated by the independent association between lean mass and bone mass through adolescence: A cross-sectional study. *Journal of Bone Mineral Metabolism, 26*(3), 288-194.

World Health Organization (WHO). (2013). *Childhood overweight and obesity*. Retrieved from http://www.who.int/dietphysicalactivity/childhood/ed/

World Health Organization Europe. (2013). *Obesity facts and figures.* Retrieved from http://www.euro.who.int/en/what-we-do/health-topics/noncommunicable-diseases/obesity/facts-and-figures.

Wright, K. N. (2011). Influence of body mass index, gender, and Hispanic ethnicity on physical activity in urban children. *Journal for Specialist in Pediatric Nursing, 16*(2), 90-104.

Zapata, L. B., Bryant, C. A., McDermott, R. J., & Helelfinger, J. A. (2008). Dietary and physical activity behaviors of middle school youth: The youth physical activity and nutrition survey. *The Journal of School Health, 78*(1), 9-18.

Zhu, W., Safrit, M., & Cohen, A. (1999). *The national health-related physical fitness knowledge test: FitSmart test user manual (high school edition).* Champaign, IL: Human Kinetics.

# APPENDIX A

DATA COLLECTION

PROTOCOLS

SCHOOL SIGN IN

1. Upon entrance to school, immediately report to the office to sign in.

2. Introduce yourself, state your purpose, and obtain a nametag if requested by the school.

3. Report to the teacher/class expecting you at the prearranged time. Please do not be late.

If you are late, or get behind schedule, please do not rush through your data collection.

We will schedule a make up day if needed.

BMI

BMI data collection methods and procedures used will be in accordance with Nihiser A, et al. Body mass index measurement in schools. J Sch Health. 77:651-671, 2007 and Himes, J. H. Challenges of accurately measuring and using BMI and other indicators of obesity in children. Pediatrics. 124;S3, 2009. The following lists the BMI data collection protocol.

1. Equipment

a. Student weight and height will be measured using a Seca ® scale and stadiometer.

2. Methods

a. Only students with parent/legal guardian permission slips will participate.

b. Student will remove his/her shoes, coat or other heavy clothing, and items from pockets that may interfere with measurement accuracy.

c. Student will be measured, repositioned, and then measured a second time to ensure the two measurements agree within 0.25 inch for height and 0.1 pound for weight.

3. Policies to ensure student privacy

a. Researcher taking measurements will be briefed on how to appropriately respond to any questions from students about the measurements.

b. Students will approach equipment with their back facing measurement display in a screen setting to insure privacy

c. Trained researchers will record measurements on data sheets without discussion with other researchers or student participants

d. All measurements will be taken out of sight and hearing distance of other students. Trained staff will be the only person seeing the measurement and will not verbalize the information.

PACER

The PACER methods and procedures used will be in accordance with FitnessGram & ActivityGram (Meredith & Welk, 2010). The following are the PACER protocols.

1. Mark the 15-meter course with marker cones to divide lanes and a tapeline at each end.
2. Obtain a copy of the PACER CD.
3. Make copies of the score sheet for each group of students to be tested.
4. Prior to the test, allow students to listen to the instructions on the CD so that the students know what to expect.
5. Student should run across the 15-meter distance and touch the line with their foot by the time the beep sounds. At the sound of the beep, they turn around and run back to the other end. If some students get to the line before the beep, they must wait for the beep before running the other direction. Students continue in this manner until they fail to reach the line before the beep for the second time.
6. The first time a student does not reach the line by the beep, the student stop where he or she is and reverses the direction immediately, attempting to get back on pace. The test is completed for a student the next time (second time) he or she fails to reach the line by the beep (the two misses do not have to be consecutive; the test is over after two total misses.
7. The recorded score is the total number of laps completed by the student. It is permissible to count the first miss. It is important to be consistent in the method used for counting with all of the students and classes.

# Physical Fitness Knowledge Survey

Physical Fitness Knowledge Survey will be administered in accordance with South Carolina Physical Education Assessment Program (2007).

1. Explain the survey to the students

2. Provide each student with a pencil

3. Pass out surveys

4. Make sure each student is working on his or her own and not sharing answers with each other. Ensure a quiet environment and allow 20 minutes for students to complete surveys. Warn students when there is 5 minutes and 1 minute remaining. Make yourself available to answer questions about the survey. If the students finish early, ask them to sit quietly and wait for everyone to finish.

5. Collect surveys, making sure each student has written their name on the top as well as answered as many questions as time allowed them to, to the best of his or her own knowledge.

# APPENDIX B

Females:

| | Body Mass Index | | | |
|---|---|---|---|---|
| Age | NI – Health Risk | NI | HFZ | Very Lean |
| 5 | ≥ 18.5 | ≥ 16.9 | 16.8 – 13.6 | ≤ 13.5 |
| 6 | ≥ 19.2 | ≥ 17.3 | 17.2 – 13.5 | ≤ 13.4 |
| 7 | ≥ 20.2 | ≥ 18.0 | 17.9 – 13.6 | ≤ 13.5 |
| 8 | ≥ 21.2 | ≥ 18.7 | 18.6 – 13.7 | ≤ 13.6 |
| 9 | ≥ 22.4 | ≥ 19.5 | 19.4 – 14.0 | ≤ 13.9 |
| 10 | ≥ 23.6 | ≥ 20.4 | 20.3 – 14.3 | ≤ 14.2 |
| 11 | ≥ 24.7 | ≥ 21.3 | 21.2 – 14.7 | ≤ 14.6 |
| 12 | ≥ 25.8 | ≥ 22.2 | 22.1 – 15.2 | ≤ 15.1 |
| 13 | ≥ 26.8 | ≥ 23.0 | 22.9 – 15.7 | ≤ 15.6 |
| 14 | ≥ 27.7 | ≥ 23.7 | 23.6 – 16.2 | ≤ 16.1 |
| 15 | ≥ 28.5 | ≥ 24.4 | 24.3 – 16.7 | ≤ 16.6 |
| 16 | ≥ 29.3 | ≥ 24.9 | 24.8 – 17.1 | ≤ 17.0 |
| 17 | ≥ 30.0 | ≥ 25.0 | 24.9 – 17.5 | ≤ 17.4 |
| 17+ | ≥ 30.0 | ≥ 25.0 | 24.9 – 17.8 | ≤ 17.7 |

Males:

| Age | Body Mass Index | | | |
|---|---|---|---|---|
| | NI – Health Risk | NI | HFZ | Very Lean |
| 5 | ≥ 18.1 | ≥ 16.9 | 16.8 – 13.9 | ≤ 13.8 |
| 6 | ≥ 18.8 | ≥ 17.2 | 17.1 – 13.8 | ≤ 13.7 |
| 7 | ≥ 19.6 | ≥ 17.7 | 17.6 – 13.8 | ≤ 13.7 |
| 8 | ≥ 20.6 | ≥ 18.3 | 18.2 – 14.0 | ≤ 13.9 |
| 9 | ≥ 21.6 | ≥ 19.0 | 18.9 – 14.2 | ≤ 14.1 |
| 10 | ≥ 22.7 | ≥ 19.8 | 19.7 – 14.5 | ≤ 14.4 |
| 11 | ≥ 23.7 | ≥ 20.6 | 20.5 – 14.9 | ≤ 14.8 |
| 12 | ≥ 24.7 | ≥ 21.4 | 21.3 – 15.3 | ≤ 15.2 |
| 13 | ≥ 25.6 | ≥ 22.3 | 22.2 – 15.8 | ≤ 15.7 |
| 14 | ≥ 26.5 | ≥ 23.1 | 23.0 – 16.4 | ≤ 16.3 |
| 15 | ≥ 27.2 | ≥ 23.8 | 23.7 – 16.9 | ≤ 16.8 |
| 16 | ≥ 27.9 | ≥ 24.6 | 24.5 – 17.5 | ≤ 17.4 |
| 17 | ≥ 28.6 | ≥ 25.0 | 24.9 – 18.1 | ≤ 18.0 |
| 17+ | ≥ 29.3 | ≥ 25.0 | 24.9 – 18.6 | ≤ 18.5 |

Adapted from FITNESSGRAM/ACTIVITYGRAM Test Administration Manual, Forth Edition *by the Cooper Institute, 20013, Champaign, IL: Human Kinetics.*

APPENDIX C

May 13, 2013

Get Moving South County

Dear Parent/Guardian,

The Center for Nutrition and Activity Promotion (CNAP), a California State University, Chico (CSUC) nutrition education and activity promotion program, will be administering a physical activity knowledge survey, height & weight collection, and PACER run test in May 2013. The research findings will be used to evaluate the relationship between physical fitness and BMI in Jr. High aged children.

The data collection will take about 30 minutes and will be given during regular school hours. There is no anticipated risk or harm to your child. Participation is completely voluntary, and there is no penalty if you or your child chooses not to participate. During the brief survey/run/BMI collection, your child may choose not to participate at any time. Your child will not be identified by name and all information is confidential.

If you have any questions, please feel free to contact Becky Avilla at ravilla@mail.csuchico.edu

**If you want your child to participate, please sign below and have your child return this permission slip to his/her teacher** by **Friday, May 17th**. Thank you for your help with this research project.

Sincerely,

Becky Avilla
Community Health Assistant
CSU, Chico
209-996-0622

Michele Buran, MA
Physical Activity Specialist
CSU, Chico
530-898-4318

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Please check one box and sign and have your child return this to his/her teacher by **May 17**

☐ I want my child to participate

☐ I do NOT want my child to participate

____________________ Child Name

____________________ Guardian Name (printed)

____________________ Guardian Signature

____________________ Date

APPENDIX D

| Class Period | Grade | First Name | Last Name | - | Height (in) | Weight (lbs) |
|---|---|---|---|---|---|---|
| *1* | *7* | *John* | *Smith* | | *69.5* | *165* |
| *1* | *7* | *Jane* | *Doe* | | *62.75* | *155* |
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# APPENDIX E

### *The PACER Group Score Sheet*

Score-keeper: ____________________ Group: __________________ Date: ___________

Laps (20-meter lengths)

| Min | Laps | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | | | | | | |
| 2 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | | | | | | |
| 3 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | | | | | | |
| 4 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | | | | | |
| 5 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | | | | | |
| 6 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | | | | |
| 7 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | | | | |
| 8 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | | | |
| 9 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | | | |
| 10 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | | | |
| 11 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | | |
| 12 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | | |
| 13 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | |
| 14 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 140 | 141 | 142 | 142 | 144 | |
| 15 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | |

| Lane | Student name | Laps completed |
|---|---|---|
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Adapted from FITNESSGRAM/ACTIVITYGRAM Test Administration Manual, Fourth Edition *by the Cooper Institute, 2005, Champaign, IL: Human Kinetics.*

# APPENDIX F

| PACER (15m) Laps | | |
|---|---|---|
| Age | Male | Female |
| 10 | 21 | 21 |
| 11 | 25 | 25 |
| 12 | 31 | 30 |
| 13 | 38 | 32 |
| 14 | 47 | 35 |
| 15 | 55 | 39 |
| 16 | 62 | 42 |
| 17 | 66 | 46 |
| 18 | 70 | 49 |

Adapted from FITNESSGRAM/ACTIVITYGRAM Test Administration Manual, Forth Edition *by the Cooper Institute, 20013, Champaign, IL: Human Kinetics.*

APPENDIX G

**Middle School Physical Education Cognitive Assessment**
**Answer Key Version B**

This assessment has been created to measure your physical education knowledge about physical fitness. Your cooperation in completing this test to the best of your ability is appreciated. You will be given (20 minutes) to complete the test. Read each question and decide which is the BEST answer to the question. If you are unsure of an answer, mark the answer you think correct.

NAME: ________________________________ SCHOOL: ____________________

**Matching: Write the letter from column B that matches each idea in column A.**

__H__ 1. Term for ability of muscles to produce force
__E__ 2. An example of a muscular strength or muscular endurance activity
__G__ 3. Term for how often you exercise
__J__ 4. Term for ability of heart to supply oxygen to body
__A__ 5. An example of a cardiovascular activity
__F__ 6. Term for how long you exercise
__B__ 7. Term for range of joint movement
__C__ 8. Term for how hard you exercise
__D__ 9. Term for ratio of fat to muscle, bone and tissue in body.
__I__ 10. An example of a flexibility activity

A. Jogging
B. Flexibility
C. Intensity
D. Body Composition
E. Push-ups or curl-ups
F. Time/duration
G. Frequency
H. Muscular strength/endurance
I. Sit and reach
J. Cardiovascular fitness

**Multiple choice: Print the letter of the best answer on the line in front of each question.**

__B__ 11. A person trying to improve cardiovascular fitness should exercise at least ________ times(s) each week.
A. 1
B. 3
C. 5
D. 7

__A__ 12. Which of the following is/are important to do when stretching before physical activity?
A. Warm up muscles before you stretch
B. Stretch your joint beyond where it starts to hurt.
C. Bounce to increase how far you can stretch
D. Base you improvement against your friends' flexibility

__D__ 13. Which of the following can cause an activity-related injury?
A. Starting activity at full speed
B. Not stretching before activity
C. Hard fast movements without a warm-up
D. All of the above

__B__ 14. If you want to improve your ability to jog faster and longer you should ___________.
- A. jog slower for the same distance you jog now
- B. slowly increase both the speed and distance you jog
- C. jog at the same speed for the same distance you are jogging now
- D. wait three weeks then increase the speed and distance you jog

__C__ 15. Which is true about body composition?
- A. Body Composition is not affected by exercise.
- B. Your body composition stays the same as you grow.
- C. The acceptable level of body fat for girls is higher than for boys.
- D. Older people always have a higher percent body fat than younger people.

__C__ 16. A person who lifts the same amount of weight every time he/she works out is ignoring which training principle?
- A. Flexibility
- B. Frequency
- C. Intensity
- D. Specificity

__D__ 17. Which of the following activities has the best chance of helping you lose weight?
- A. Archery
- B. Bowling
- C. Gymnastics
- D. Soccer

__A__ 18. Which activity has the best chance of improving abdominal strength?
- A. Curl-ups
- B. Flexed-arm hang
- C. Jogging
- D. Swimming

__D__ 19. As the body adapts to exercise, what must a person do to continue improving?
- A. Avoid lifting heavier weights
- B. Keep working out for the same length of time
- C. Work out the same number of times each week
- D. Gradually increase the intensity or duration.

__D__ 20. If two people are the same weight, which of the following is true? Both people __________.
- A. will be the same age
- B. will be the same height
- C. will be boys or both will be girls
- D. could have different percent body fat

**Key Version B 10/2006**

South Carolina Physical Education Assessment Program. (2007). *Middle school physical education program assessment manual.* Columbia, SC: Author.