An investigation of aerobic fitness, perceived quality of life and the direct effects of self-determination theory in college students

Alanna Darling

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An Investigation of Aerobic Fitness, Perceived Quality of Life and the Direct Effects of
Self-Determination Theory in College Students

by

Alanna Darling

Thesis Submitted in Partial Fulfillment of
the Requirements of the Masters of Science in Exercise Science Degree

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ABSTRACT

There have been numerous studies examining the association between physical activity, motivation and quality of life. In contrast, studies focusing on aerobic fitness and its relationship with levels of motivation and perceived quality of life are lacking. The purpose of this study was to explore the relationship between a direct measure of aerobic fitness, behavioral regulations, and perceptions of quality of life in college-aged sample. Participants included both males ($n=129$; 21.1±1.8 years) and females ($n=89$; 20.8±1.4 years) who completed the Behavioral Regulations of Exercise Questionnaire-2 sub-scores and Perceived Quality of Life (PQoL) instruments. Participants then performed the Queen’s College Step test for three minutes and recovery heart rate was assessed one minute later to determine aerobic fitness. A path analysis was used to examine the relationship between levels of Behavioral Regulation sub-scores (i.e. intrinsic regulation and identified regulation) and Perceived Quality of Life, and recovery heart rate. Statistical significance was set at $p \leq 0.05$. The results of this study indicated that there was no significant association between behavioral regulation sub scores and aerobic fitness. Further, there was no significant relationship between aerobic fitness and PQoL. Results also indicated that there was no significant indirect effect between measures of behavioral regulation (i.e. identified and intrinsic regulation) and PQoL. The results provide insight into the direction of future studies in regards to how cardiorespiratory fitness may be different than physical activity in improving motivation and life satisfaction within a college population.
ACKNOWLEDGEMENTS

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>PAGE</th>
<th>CONTENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>iii</td>
<td>ABSTRACT</td>
</tr>
<tr>
<td>iv</td>
<td>ACKNOWLEDGEMENTS</td>
</tr>
<tr>
<td>vii</td>
<td>LIST OF TABLES AND FIGURES</td>
</tr>
<tr>
<td></td>
<td>CHAPTER</td>
</tr>
<tr>
<td></td>
<td>1. INTRODUCTION</td>
</tr>
<tr>
<td></td>
<td>Statement of the Problem</td>
</tr>
<tr>
<td></td>
<td>Purpose of the Study</td>
</tr>
<tr>
<td></td>
<td>Significance of the Study</td>
</tr>
<tr>
<td></td>
<td>Delimitations</td>
</tr>
<tr>
<td></td>
<td>Limitations</td>
</tr>
<tr>
<td></td>
<td>Assumptions</td>
</tr>
<tr>
<td></td>
<td>Research Hypotheses</td>
</tr>
<tr>
<td></td>
<td>Operational definition of terms</td>
</tr>
<tr>
<td>11</td>
<td>2. REVIEW OF LITERATURE</td>
</tr>
<tr>
<td></td>
<td>Quality of Life</td>
</tr>
<tr>
<td></td>
<td>Health-Related Quality of Life</td>
</tr>
<tr>
<td></td>
<td>Importance of Physical Activity and Quality of Life</td>
</tr>
<tr>
<td></td>
<td>Importance of Physical Activity and Psychological Well-Being</td>
</tr>
<tr>
<td></td>
<td>Quality of Life in College Students</td>
</tr>
<tr>
<td></td>
<td>Quality of Life and Gender Differences</td>
</tr>
<tr>
<td></td>
<td>Self-Determination Theory</td>
</tr>
<tr>
<td></td>
<td>Self-Determination Theory and Physical Activity</td>
</tr>
<tr>
<td></td>
<td>Self-Determination, Physical Activity and College Students</td>
</tr>
<tr>
<td></td>
<td>Summary</td>
</tr>
<tr>
<td>30</td>
<td>3. MANUSCRIPT</td>
</tr>
<tr>
<td></td>
<td>Introduction</td>
</tr>
<tr>
<td></td>
<td>Participants</td>
</tr>
<tr>
<td></td>
<td>Psychological measures</td>
</tr>
<tr>
<td></td>
<td>Physical measures</td>
</tr>
<tr>
<td></td>
<td>Anthropometric measures</td>
</tr>
<tr>
<td></td>
<td>Statistical Analyses</td>
</tr>
<tr>
<td></td>
<td>Results</td>
</tr>
<tr>
<td></td>
<td>Discussion</td>
</tr>
<tr>
<td></td>
<td>Limitations</td>
</tr>
<tr>
<td></td>
<td>Future Recommendations</td>
</tr>
<tr>
<td></td>
<td>Conclusions</td>
</tr>
<tr>
<td></td>
<td>Acknowledgements</td>
</tr>
</tbody>
</table>
REFERENCES ........................................................................................................51

APPENDICES ....................................................................................................63

  A. Institutional Review Board Approval Letter..................................................63
  B. Informed Consent..........................................................................................65
  C. Demographic and Physical Activity Readiness Questionnaire (PAR-Q ..........69
  D. Behavioral Regulations in Exercise Questionnaire-2 (BREQ-2.................70
  E. Perceived Quality of Life (PQoL) Scale.......................................................72
  F. Ratings of Perceived Exertion (RPE) Scale .................................................77
  G. Male Normative Values for Recovery Heart Rate......................................78
  H. Female Normative Values for Recovery Heart Rate..................................79
LIST OF TABLES AND FIGURES

TABLE  PAGE
1. Descriptive Statistics for Participants Characteristics ..................................................35
2. Descriptive Statistics for Academic Year and Major of Study Participants.................35
3. Descriptive Statistics for Ratings of Perceived Exertion (RPE) ..................................39
4. Descriptive Statistics for Behavioral Regulations, Perceived Quality of Life, and Aerobic Fitness Measures ........................................................................................................40
5. Test Results of All Variables ...........................................................................................40

FIGURE  PAGE
1. Schematic of Self-Determination Theory ........................................................................23
2. Path Analysis Model ........................................................................................................41
CHAPTER 1

Introduction

Quality of life is defined as the “individuals’ perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns” (World Health Organization [WHO], 1993; 1998). The breadth of this definition includes the consideration of a number of domains which may be positively or negatively impacted and thus influence the individual’s “perception of their position”, such as: (a) physical health, (b) psychological well-being, (c) degree of independence, (d) social interactions, (e) personal beliefs, and (f) the interactive effects with the environment. The subjective nature of these appraisals mixed with cultural complexities has made quality of life a difficult construct to measure (Centers for Disease Control and Prevention [CDC], 2011). To address this issue, domains are investigated individually. Of those domains which comprise quality of life, physical health continues to receive considerable attention. Health-related quality of life (HRQoL) is a subcategory of the larger quality of life construct and reflects varying degrees of functioning in the areas of (a) physical, (b) emotional, (c) social, and (d) cognitive as well as overall health status (Lox, Martin Ginis, & Petruzzello, 2014). HRQoL is defined as those “aspects of overall quality of life that can be clearly shown to affect health” such as the “physical and mental health perceptions and their correlates, including health risks and conditions, functional status, social support, and socioeconomic status” (CDC, 2011).

The importance of physical health as it relates to both the broader QoL and specific HRQoL constructs can be seen with respect to physical activity trends.
Encouraging regular participation in physical activity is a worldwide public health priority (WHO, 2004) and the benefits are notable. For example, performing moderate physical activity (e.g., walking) on most days of the week (e.g., five days) decreases the risk of death from cardiovascular diseases by 30% (Leitzman et al., 2007).

According to the CDC, however, the percentage of adults 18 years of age and older in the United States who met the 2008 physical activity guidelines, which are defined as 150 minutes per week of moderate-intensity or 75 minutes per week of vigorous-intensity aerobic activity along with resistance training exercise, was 48% (2012). This statistic is corroborated with 2013 data from the Behavioral Risk Factor Surveillance System (BRFSS) which indicated that over 79% of respondents did not participate in enough aerobic and muscle strengthening exercises to meet guidelines. Collectively, these findings may explain, in part, data from the same survey which indicated that approximately 47% of respondents reported “Good,” “Fair,” or “Poor” to the question “How is your general health?” (BRFSS, 2013). A nominal increase in daily physical activity would enable most American adults to improve their health and quality of life (Blair et al., 1989) as moderate-to-high levels of physical activity alleviate the negative effects associated with sedentary behavior.

There are numerous reasons individuals use to justify why they do not partake in physical activity. To better understand these perceived barriers to regular physical activity, it may be helpful to examine expectancy-value theories to explain the motivation (or lack thereof) to engage in physical activity. One such theory which is derived from this approach is self-determination theory (Deci & Ryan, 1985). Self-determination theory is a multi-layered framework which assumes an interaction among different levels.
A primary level of the theory posits that satisfying the three basic psychological needs of (a) autonomy, (b) relatedness, and (c) competence influences a continuum of motivational categories. Specifically, three categories of motivation are identified as: (a) amotivation, (b) extrinsic motivation, and (c) intrinsic motivation. Along this continuum starting with extrinsic motivation and working towards intrinsic motivation, certain regulatory mechanisms can have an influence on an individual’s behavior. Moving from extrinsic towards intrinsic motivation, these behavioral regulations are: (a) external regulation, (b) introjected regulation, (c) identified regulation, and (d) integrated regulation. According to predictions from self-determination theory, autonomous motivation should positively link with overall indices of health and well-being, such as HRQoL, which is supportive of one’s inherent tendencies toward psychological growth, development, and overall adjustment (Deci & Ryan, 2008).

While research continues to support the benefits of exercise and the related improvements on physical and mental health, most college students remain unperturbed and do not exercise. Findings of physical inactivity among college students vary in prevalence according to whether the study is a local investigation (Hicks & Miller, 2006) or a national survey (BRFSS, 2012). Regardless, approximately 50% of the participants in exercise programs drop out in the first three to six months (Dishman & Buckworth, 1996). However, there is evidence that the decision to engage or not in physical activity in college (at least during your final year) may predict physical activity levels post-baccalaureate. In 2002, Sparling and Snow found that 84.7% of college seniors who exercised regularly were still physically active 5 to 10 years later. Likewise, they found the same trend among those who were inactive — 81.3% of those who were physically
inactive as college seniors maintained a sedentary lifestyle. Similar findings of physical inactivity were found by Grunbaum et al. (2001) who reported that almost half of all college students report a decrease in physical activity following graduation.

Quality of life is a broad ranging concept affected in a complex way by the person’s physical health, psychological state, and level of independence, social relationships, and their relationships to salient features of their environment. (WHOQOL Group, 1993). In regards to exercise, the subjective evaluation is a better measure for health-practitioners to use when assessing satisfaction with one or more HRQoL domains. Six domains HRQoL have been identified: (a) psychological health, (b) physical health, (c) spirituality, (d) level of independence, (e) social relationships, and (f) environment (WHO, 1993). Improvements in HRQoL are recognized as an important benefit of exercise and awareness of one’s HRQoL is valuable for prescribing exercise. Favorable outcomes among those students who participated in a recommended dose of physical activity were more likely to have an improved HRQoL and perceived health status as seen in (Brown et al., 2003; Sundblad, Jansson, Saartok, Renstrom, & Engstrom, 2008; Zahran, Zack, Vernon-Smiley, & Hertz, 2007).

Collectively, there is evidence of relationships between physical activity and quality of life and, physical activity and motivational regulations. What is less clear is the relationship amongst the triad of physical activity, quality of life, and motivational regulations. Given that researchers have advocated for a greater research focus on the health of college students (Keating, Guan, Piñero, & Bridges, 2005; Stewart-Brown, et al., 2000), understanding this tripartite relationship may provide insight as to how to improve exercise programming with college students. Identifying motivational
regulations of exercise may help establish enduring and satisfying patterns of exercise behavior (such as enhanced mood and personal satisfaction; Ingledew, Markland, & Sheppard, 2004; Sebire, Standage, & Vansteenkiste, 2009; Wilson & Rodgers, 2004) and, thus, enhance one’s quality of life.

Accordingly, to gain more insight into how aerobic endurance is related to (a) the behavioral regulations outlined using the self-determination theory and (b) the overall quality of life in college students, the current study will examine whether aerobically fit college-aged students display greater intrinsic motivation regulations and report a better quality of life when compared to less aerobically fit students.

**Statement of Problem**

Despite the many clear benefits of an active lifestyle (i.e., improving longevity, keeping heart disease, diabetes, and a host of other diseases at bay, relieving symptoms of depression and anxiety, while improving mood and many more), lack of physical activity is a significant health problem in the college population (Kilpatrick, Hebert, & Bartholomew, 2005). From the past studies presented the specific elements of physical activity, such as cardiorespiratory fitness in a college population is in need of further research. There is a consistent line of research that suggests a relationship between physical inactivity and low quality of life/physical activity and better quality of life. There is also considerable evidence suggesting a link between physical activity and SDT measures and QoL measures. However, what is less clear is the relationship between such measures and a measure of physical fitness, specifically cardiorespiratory fitness.
**Purpose of the Study**

The purpose of this study was to explore the relationship between aerobic fitness and its effect on self-determination and perceived quality of life. More specifically, the objective of this study is to if college-age students who are more aerobically fit tend to be more intrinsically motivated and have a better perceived quality of life when compared to their counterparts who are less aerobically fit. Additionally, this study compared the relationship between aerobic fitness and different levels of behavioral regulations (i.e. intrinsic regulation and identified regulation) as well as the interaction effect between perceived quality of life and the behavioral regulations (i.e. intrinsic regulation and identified regulation).

**Significance of Study**

While much is known about the benefits to be gained when participating in physical activity and its positive influence on self-determination and perceived quality of life, little research has examined the correlation that exists among the two independent variables listed above and aerobic fitness in a college setting. By better understanding how behavioral regulations are related with aerobic fitness, it may facilitate the development, prediction, modification, and adherence to exercise programs in the college population. If results suggest there is a relationship between aerobic fitness, self-determination, and quality of life, future research can examine how to overcome situations that limit a person’s involvement with physical activity.

**Delimitations**

The following study was delimited to:

1. Only university students and non-athletes were asked to participate in the study.
2. Participants will be recruited via campus-wide email, flyers, class announcements, and word-of-mouth.

3. Only the Behavior Regulations in Exercise Questionnaire-2 and Perceived Quality of Life Scale will be used to conduct this research.

4. Aerobic endurance will be estimated using a 3-minute step test.

5. Only one dimension of quality of life will be assessed (i.e. physical fitness).

Limitations

The following study was limited to:

1. The population that will be sampled for the study represents a convenient sample of college-aged students.

2. Truthfulness of the participant responses cannot be guaranteed.

3. Physical fitness is being estimated rather than directly measured.

4. The measure of quality of life is typically used for individuals with some disease or chronic condition and not for a relatively healthy sample.

Assumptions

The following assumptions are made for this study:

1. The information from each participant provided was honest and accurate.

2. The self-reported responses were based on their own knowledge and without the influence of others.

3. The 3-minute step test is an adequate estimate of an individual’s cardiorespiratory fitness.
Research Hypotheses

1. Research Hypothesis 1: There will be a significant relationship between aerobic fitness, as measured by recovery heart rate, and perceived quality of life (PQoL) scores.

2. Research Hypothesis 2: There will be a significant relationship between aerobic fitness, as measured by recovery heart rate, and behavioral regulations as measured by BREQ-2 scores.

Operational Definition of Terms

Aerobic physical activity – activity in which the body's large muscles move in a rhythmic manner for a sustained period of time. Aerobic activity, also called endurance activity, improves cardiorespiratory fitness. Examples include walking, running, swimming, and bicycling (Centers for Disease Control & Prevention [CDC], 2011).

Amotivation – the lack of both extrinsic and intrinsic motivation and is characterized by the lack of value for an activity, or the belief that the activity will not result in desired outcomes (Deci & Ryan, 1985).

External regulation – behaviors that are regulated through external means such as rewards or punishment (e.g., exercising because of pressure from significant others; Deci & Ryan, 1985; Ryan & Deci, 2000).

Extrinsic motivation – engaging in a behavior because they value its associated outcomes as opposed to the activity itself (Ryan & Deci, 2000).

Health-related quality of life – is a subcomponent of quality of life that reflects the “goodness” of those dimensions of life that can be affected by health and by health
interventions, such as one’s physical function, emotional well-being, and ability to fulfill family and other social roles (Lox, Martin Ginis, & Petruzzello, 2003).

**Identified regulation** – represents a relatively self-determined regulation because the outcomes of the behavior are highly valued (e.g. exercising to improve physical fitness), and the behavior is performed with no pressure, even if it is not particularly enjoyable (Deci & Ryan, 1985; Ryan & Deci, 2000).

**Integrated regulation** – represents the most self-determined form of the internalization process. It refers to behaviors that are performed out of choice to harmonize and bring coherence to different parts of the self (Deci & Ryan, 1985; 1995).

**Intrinsic motivation** – the inherent tendency to seek out novelty and challenges, to extend and exercise one’s capability, to explore, and to learn (Ryan & Deci, 2000).

**Introjected regulation** – behaviors that are partially internalized, but they are not fully self-determined. These behaviors are performed to gain social approval and self-worth or to avoid internal pressure and negative feelings (e.g. exercising to avoid feelings of guilt) (Deci & Ryan, 1985; Ryan & Deci, 2000).

**Perceived quality of life** – PQOL has been defined as one's cognitive appraisal of his or her overall satisfaction with life (Diener, 1994).

**Quality of life**- is a broad multidimensional concept that usually includes subjective evaluations of both positive and negative aspects of life (World Health Organization Quality of Life [WHOQOL] Group, 1998) and as the individuals’ perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. It is a broad ranging concept affected in a complex way by the person's physical health, psychological state, level of
independence, social relationships, personal beliefs and their relationship to salient features of their environment (Saxena & Orley, 1997).
CHAPTER 2

Review of Literature

The purpose of this study is to further expound upon the concept of aerobic fitness levels and its relationship with quality of life measures and motivational regulations among a college-aged sample. In order to do this, past literature must be observed and understood. It is generally accepted that physical activity can provide an abundance of positive benefits not only in the physical sense, but in the mental and spiritual sense as well. Yet, despite this fact, college students are adopting a more sedentary and less active lifestyle. Understanding college student’s motivation to engage in physical activity, specifically in regards to two behavioral regulations, identified and intrinsic motivation, as well as students perceived level of life satisfaction was investigated. In accordance with the existing literature, the more an individual engages in physical activity is thought to be positively associated with that individual’s quality of life. This study sought to determine the link between aerobic fitness levels, motivational regulations, and perceived quality of life in a sample of college-aged participants.

Quality of Life

In 1948, the World Health Organization (WHO) broadened their definition of health as not only the absence of disease and infirmity, but also the presence of physical, mental, and social well-being. The transition to a broader definition implied the importance of one’s satisfaction with his or her life and environment, including health, recreation, culture, rights, values, beliefs, and aspirations (Healthy People, 2010). Closely aligned with this idea of health is the concept of QoL. Quality of life is an individual perception of the overall state of satisfaction with one’s life. The government initiatives
Healthy People 2000, 2010, and 2020 have each identified the enhancement of an individual’s quality of life as a primary public health target (CDC, 2011). There are two broad dimensions which comprise QoL; a psychological dimension and a physical dimension, these have been further delineated by the WHO (1993). Psychological health refers to the integration of various sensory functions; the ability to think, learn, memorize, and concentrate; and self-esteem factors such as body image and appearance. Physical health is associated with pain regulation, feelings of energy or fatigue, sexual activity, and amount of sleep. An individual’s level of independence also influences QoL by how mobile one is and how well one can complete activities of daily living. As such, scholars have noted that QoL research remains an important area of investigation (Megahed, 2014). Given that health is closely associated with QoL, it is important to consider the more specific subcategory of health-related quality of life (HRQoL).

**Health-related Quality of Life**

Health is reflected as an element of both QoL and HRQoL, even though each element denotes different features. HRQoL can be conceptualized as a subcomponent of QoL that represents the goodness of the dimensions of life that can be influenced by health (Lox, Martin Ginis, & Petruzzello, 2003). In particular, physical function, emotional well-being, and the ability to fulfill social roles are critical to the conceptualization of HRQoL. Measuring HRQoL allows researchers to determine an individual’s perceptions about their health and the influence it has on their lives. By better understanding the influences of HRQoL, researchers and healthcare practitioners can more easily realize therapeutic techniques that will enhance all three components of health (physical, mental, and social well-being; Lox et al., 2010).
Importance of Physical Activity and Quality of Life

According to the WHO, inactivity is categorized as the fourth leading cause of mortality causing an estimated 3.2 million deaths per year, after high blood pressure, smoking, and blood glucose. Additionally, the U.S Department of Health and Human Services (2015) states that low cardiorespiratory fitness is an established risk factor for heart disease, heart disease and stroke are two of the leading causes of death in the United States and reducing this trend of physical inactivity is critical in the prevention of mortality. When adults remain regularly active they have a reduced chance of having heart disease and a stroke because regular engagement in aerobic exercise aids in strengthening the cardiovascular system (Mersy, 1991). Aerobic exercise defined by (CDC) is an activity in which the body's large muscles move in a rhythmic manner for a sustained period of time, such as walking, running, swimming, and biking all of which improve physical functioning and cardiorespiratory fitness. Aerobic exercise can be performed by doing light, moderate, or vigorous intensity. Determining the level of intensity will be dependent on how much effort an individual is willing to put forth in order to receive the benefits. The CDC and American College of Sports Medicine (ACSM) suggest that adults accumulate 30 minutes of moderate activity 5days/week or 20 minutes of vigorous activity 3days/week, or a combination of both.

Physical and functional health refers to an individual’s biological functioning and physical activities of daily living (ADL), respectively. Measurable physical and functional behaviors, such as breathing, walking, or caring for one’s own needs, can be indicators of good health (Lawton, 1983). Researchers have noted a consistent relationship between level of physical function and QoL in older adults. In 1989,
McPhillips, Pellettera, Barrett-Connor, Wingard, and Criqui studied, perceived versus actual physical function, health status, and well-being in a sample of older adults. Those participants who reported fewer limitations with their physical functioning exercised nearly twice as much as those who reported more physical limitations. Relatedly, Tomey and Sowers (2009) found that 21% of participants between the ages of 60 to 69 years reported difficulty or inability to walk a quarter of a mile. That percentage increased to 30% and 49% for those who were 70 to 79 years of age and above 80 years old, respectively. Likewise, a study by Shrir...
and the relationship with physical activity and QoL, where after a 6-month physical activity program was implemented, significant improvement in physical self-perception and reductions in binge eating behaviors were seen, positively affecting their QoL. Other cases have also found that, short-term interventions aimed at establishing healthy behaviors (i.e., physical activity and proper dietary habits) do appear to be somewhat successful (Newton, Kim, & Newton, 2006).

In short, there is accumulating evidence of the relationship between physical functioning and QoL across age groups and chronic diseases and conditions. A meta-analysis of 56 exercise intervention studies determined that exercise results in significant improvements in perceptions of physical functioning (Lox, Martin Ginis, & Petruzzello, 2010). Exercise interventions focusing on perceptions of social functioning concluded that exercise can have a positive effect on the social lives of elderly men and women, diabetic individuals, those suffering from fibromyalgia, individuals who are clinically depressed, and those with physical disabilities. Through the use of observational studies, improved cognitive functioning was positively linked with both acute and chronic aerobic fitness, proposing that aerobic fitness may safeguard against the development of cognitive impairment, which is often observed in the elderly population. Intervention studies have demonstrated the profound positive effects from physical fitness in relation to physical, social, and cognitive functioning (Gillison, Skevington, Sato, Standage, & Evangelidou, 2009).

Thus, developing a better understanding in how to design physical activity and exercise programs tailored to each individual’s needs are positive steps toward
optimizing and obtaining improved physical functioning, health, and well-being (Durstine, Gordon, Wang, & Luo, 2013).

**Importance of Physical Activity and Psychological Well-Being**

The other primary dimension of QoL consists of psychological well-being or mental health. According to the WHO (http://www.who.int/topics/mental_health) mental health is defined as a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community. When investigating physical inactivity and depression, researchers found that lack of physical activity increases the probability of developing clinically diagnosed depression (Camacho, Roberts, Lazarus, Kaplan, & Cohen, 1991; Farmer et al., 1988; Paffenberger, Lee, & Leung, 1994; Strawbridge, Deleger, Roberts, & Kaplan, 2002). Some researchers have posited that mental health outcomes can be a motivating factor to help individuals persevere in physical activity and have a positive impact on well-being (Biddle, Fox, & Boutcher, 2000). Interestingly, there appears to be some debate as to which primary dimension of QoL is impacted greatest. Numerous studies have suggested a stronger link between perceived QoL and psychological well-being than with physical functioning (Andruškienė et al., 2011; Mechanic & Cleary, 1980; Mechanic & Tessler, 1978; Pilcher, 1998; Piko, 2000; Vaez & LaFlamme, 2002).

A meta-analysis by Long and van Stavel (1995) supported the idea that exercise provides anxiolytic effects, noting that adults with stressful lifestyles benefited more from aerobic exercise training as it acts a positive mediator of physiological and mental health (Schlicht, 1994). This is evidenced in studies in which participants who reported their
health as “better and/or same” and those who felt better regarding emotional functioning exercised twice as much as those who reported the opposite (McPhillips et al., 1989). Berger and Motl (2000) concluded that aerobic exercise facilitated reductions in anxiety because it incorporated repetitive movements, did not involve competition with others, was a predictable activity, and required a steady, relaxed breathing pattern. In other words, movement that did not require focal awareness and that was done for the inherent enjoyment appears to lead to the anxiolytic effects observed. Smits, Berry, Rosenfield, Powers, Behar, and Otto (2008) suggested that moderate to vigorous aerobic exercise significantly reduces anxiety for individuals that report high levels of anxiety sensitivity. These researchers assert that higher intensities of exercise is necessary to attain mental health benefits associated with aerobic activity because these intensities allow individuals to adapt to the routine and the physiological sensations exercise encompasses. In terms of frequency, it appears that an acute bout produces an immediate reduction in anxiety feelings (state anxiety) and a period of exercise training can reduce a predisposition to act anxiously (trait anxiety) (Mutrie & Faulkner, 2004).

Quality of Life in College Students

In college, many students face an unprecedented amount of stress during the academic year. HRQoL measures make it possible to demonstrate scientifically the impact of QoL on health (Kanarek, Sockwell, & Jia, 2000). The National Survey of Counseling Center Directors administered a survey to 274 institutions of higher learning that which revealed 85% of center directors reporting an increase in “severe” psychological problems in their student body over the last 5 years (as cited by Gallagher, Sysko, & Zhang, 2001). This finding suggests what other investigators have noted,
specifically that the transition to college life is recognized as a major life stressor (Bray & Kwan, 2006). These authors found decreases in physical health and increases in mental health among female undergraduates three months into their first year of college. Bray and Kwan (2006) further stated that a decrease in exercise participation while in college coincides with lower psychological well-being and vigor, as well as increased levels of fatigue. Likewise, Jung, Bray, and Martin Ginis (2008) found that transitioning into college life is one of the many milestones young adults will face that may impact exercise patterns. That transition is often accompanied by reductions in physical activity and exercise participation.

Keating et al. (2005) identified that physical inactivity is one of the six priority health risk behaviors for college populations and yet more than ever students are adopting a sedentary lifestyle. Similarly, additional research found that students attending college have not yet engaged in an adequate amount of physical activity that is thought to promote health benefits (Biddle & Chatzisarantis, 1999; Sundblad et al., 2008). College life is a stressful period in one's life that can result in reduced levels of HRQoL, due to common stressors among university students such as academic pressure, peer pressure, being away from home, and becoming more independent (Gyurcsik, Spink, Bray, Chad & Kwan, 2006; Hamaideh, 2011). Their worries, concerns and burdens differ from other population groups, as they are more susceptible to stress, burn out depression, and anxiety (Dyrbye, Thomas, Power, Durning, Moutier, Massie, Harper, Eacker, Szydlo, Sloan, & Shanafelt, 2012).

This increased stress manifests itself with reductions in physical activity levels which, in turn, align with deleterious psychosocial (e.g., reduced well-being) and physical
(e.g., weight gain) health outcomes (Bray & Born, 2004). Corroborating this statistic are the trends noted by Sidman, Fiala, and D’Abundo (2011) who illustrated high percentages of inactive college students ranging from 40 to 50%. Research by Haase, Steptoe, Sallis, and Wardle (2004) administered a survey reporting only 40-60% of roughly 20,000 students in 23 different countries who were aware of the health benefits that can be gained by participating in physical activity. This may explain, in part, why a large portion of students do not engage in a sufficient amount of physical activity.

While much of the QoL and HRQoL research has focused on older adults, studies on younger adults, specifically college-aged adults, have not received as much attention. Physical inactivity is not only a health problem for the general population, but mounting evidence has shown that a general decline in physical activity contributing to poorer perceived overall well-being for college students, in studies of Turkish (Dilek, Ozcan, Tasgin, & Arslan, 2013), Swedish (Vaez, Kristenson, & LaFlamme, 2004), Taiwanese (Li, Lu, & Wang, 2009) and Lithuanian (Andruškienė et al., 2011) college students consistently show the relationship between QoL and health and health-related behaviors (e.g., physical activity). Cross-culturally, greater physical activity routinely improves perceptions of QoL and health-related measures. A study by Andruškienė et al., (2011) demonstrated a consistently positive relationship between measures of a physical domain and the domains of psychological ($r = 0.52$) and level of independence ($r = 0.52$) in college students.

Studies of American college students reveal some sobering statistics regarding experience with stress, psychological well-being, and physical activity. There has been an increase in the amount of psychological distress suffered amongst college students in
comparison to their same aged non-student population. This distress has led to depression, paranoia, and hypomania amongst American college students over the past half century (Twenge, Gentile, DeWall, Ma, Lacefield & Schurtz, 2010). In 2009, Zivin, Eisenberg, Gollust, and Golberstein used a web-based survey of students attending a four year public university that looked specifically into mental disorders (anxiety, depression, and eating disorders). Over half of students suffered from at least one mental disorder at the beginning of the study and that increased to 60% in the two year follow-up. Much of this appears to be related to stressors in their life relating to anxiety and academic-related challenges, such as, course workload, grade competition, frequency of exams, time management, financial debt, and poor work/school-life balance (El-Ghoroury, Galper, Sawaqdeh, & Bufka, 2012; Misra & McKean, 2000). Studies suggest that engaging in physical activity, and at greater frequencies, is the most important positive predictor in all of the domains of HRQoL (Massidda, Cugusi, & Mathieu, 2014).

While there is mounting research on QoL and HRQoL in college-aged students, some have questioned if the population has been marginalized and needs a greater research focus (Keating et al., 2005; Stewart-Brown et al., 2000). Research by Kwan and Faulkner (2011) suggests that incoming college students understand the benefits of regular physical activity, yet show irresolution towards making it a regular part of their college tenure.

Quality of Life and Gender Differences

Previous research (Leslie, Owen, & Sallis, 1999) has shown gender differences in preferred exercise intensity and exercise modality (Leslie et al., 1999; Pinto & Marcus, 1995). Although not confirmed, Sparling and Snow (2002) proposed the idea that both
male and female students will inevitably partake in similar amounts of physical activity when they reach a certain age. However, when researchers looked further into these differences, specifically in regards to long-term habits, Buckworth and Niggs (2004) found that as time passed male students increased their physical activity time whereas female students did not. As noted previously, there appears to be cross-cultural consistency in the findings. For example, studies of Saudi Arabian (Megahed, 2014) and African-American (Hicks & Miller, 2006) college students appear to suggest that physical inactivity contributes to poorer self-reported QoL and reduced psychological well-being among female students compared to their male counterparts.

**Self-Determination Theory**

The three basic pillars of self-determination theory (SDT), originally conceived by Deci and Ryan (1985) can be beneficial to practitioners in understanding that people possess certain psychological needs. These include the need for autonomy (self-determination), the need to demonstrate competence, and the need for (social) relatedness. Social contexts which facilitate satisfaction of these three basic psychological needs will support people’s inherent activity, promote more optimal motivation, and yield the most positive psychological, developmental, and behavioral outcomes (Ryan & Deci, 2000). Determining which psychological needs are being met through physical fitness can be helpful in the prediction, modification, and adherence to exercise programs; as it has been recommended that people maintain a certain level of physical activity in order to prevent disease and preserve overall QoL (CDC, 2011).

Starting and maintaining physical activity can be motivated by a variety of reasons (Ingledew & Markland, 2008). Self-determination theory (Deci & Ryan, 1985)
offers an appropriate framework for investigating exercise behavior given its emphasis on the three major psychological forces of motivated behavior. This first level includes three forms of motivation that drive a human’s behavior: intrinsic motivation, extrinsic motivation, and amotivation. Intrinsic motivation refers to doing an activity for its inherent satisfactions rather than for some separable consequence, extrinsic motivation, pertains to doing an activity that is done in order to attain some separable outcome, and amotivation, is the lack of both extrinsic and intrinsic motivation and is characterized by the lack of value for an activity (Ryan & Deci, 2000; Deci & Ryan, 1985). However, SDT proposes that extrinsic motivation can vary greatly in the degree to which it is autonomous (Ryan & Deci, 2000). Understanding this degree of contrast is a problem that is described as fostering the internalization and integration of values and behavioral regulations (Deci & Ryan, 1985). The process of internalization is taking in value or regulation in which an individual more fully transforms the regulation so that it will emanate from their sense of self (Ryan & Deci, 2000).

The second level in SDT theory consists of the regulatory conditions of the three forms of motivation, which are thought to work on a continuum. This continuum can be defined as how an individual’s motivation for behavior can range from the lowest self-determined form (amotivation) or unwillingness, to passive compliance, to active personal commitment (Ryan & Deci, 2000). When an individual increases in their internalization, there is a shift along the continuum from amotivation towards extrinsic motivation. External regulation represents the least autonomous form of extrinsic motivation, which is a behavior that is regulated through external means such as rewards or punishment (e.g., exercising because of pressure from significant others; Deci & Ryan,
Continuing to the right, the second regulatory condition within extrinsic motivation is introjected regulation, which reflects behaviors that are partially internalized, but they are not fully self-determined. These behaviors are performed to gain social approval and self-worth or to avoid internal pressure and negative feelings (e.g. exercising to avoid feelings of guilt; Deci & Ryan, 1985; Ryan & Deci, 2000). The third regulatory condition, which is thought to be a more self-determined form of extrinsic motivation is identified regulation, where the outcomes of this behavioral regulation are highly valued (e.g. exercising to improve physical fitness), and the behavior is performed with no pressure, even if it is not particularly enjoyable (Deci & Ryan, 1985; Ryan & Deci, 2000). Lastly, the most self-determined form of extrinsic motivation is integrated regulation, which refers to behaviors that are performed out of choice to harmonize and bring coherence to different parts of the self (Deci & Ryan, 1985; 1995). Opposite amotivation on this motivational continuum is intrinsic motivation, which is defined as doing an activity for its inherent satisfactions rather than for some separable consequence (Ryan & Deci, 2000). Understanding motivation and how it can be manipulated to a more valued behavior can be beneficial in exercise interventions.

Figure 1. Schematic of Self-Determination Theory.
The SDT approach has been successfully applied across a lifespan, in various cultures and in many life domains, including physical activity, health, sport, education, work and so forth, revealing the significant role of different types of motivation and their influence on behavioral outcomes. Self-determination theory assumes that people are, by nature, active and self-motivated, curious and interested, vital, and eager to succeed because success itself is personally satisfying and rewarding. The theory recognizes, however, that people can also be alienated and mechanized, or passive and disaffected (Deci & Ryan, 2008). Authors Hagger and Chatzisarantis (2008) claimed that public health researchers have been particularly intrigued in the psychological influences on exercise behavior because it is believed these can be manipulated through intervention to change one’s behavior.

**Self-Determination Theory and Physical Activity**

Researchers have found that people who report more self-determined motives also report more regular physical activity including exercise, as well as more positive physical and psychological outcomes of physical activity participation (e.g., Hagger & Chatzisarantis, 2007; Landry & Solomon, 2004; Mullen & Markland, 1997; Sebire, Standage, & Vansteenkiste, 2009; Standage, Sebire, & Loney, 2008; Wilson & Rodgers, 2002; 2004; Wilson, Rodgers, Fraser, & Murray, 2004). When investigating differences between regular and non-regular exercisers, it was found that non-regular exercisers were the least self-determined and regular exercisers were the most self-determined (Rodgers, Hall, Duncan, Pearson, & Milne, 2010). Furthermore, more self-determined regulations have been found to be more strongly associated with exercise persistence (Hagger & Chatzisarantis, 2008).
Autonomy, or having a sense of choice and being able to determine one’s actions, is considered to be a fundamental psychological need (Deci & Ryan, 2000; 2008). It is essential to psychological well-being and QoL (e.g., Langer & Rodin, 1976). Furthermore, autonomous types of motivational regulation display higher levels of physical functioning and personal adaptation than more controlling types (Deci & Ryan, 2000), indicating that more highly self-determined motivation is associated with more desirable consequences such as well-being (Vallerand, 1997; Vallerand & Losier, 1999).

When investigating adolescents, Power, Ullrich-French, Steele, Daratha, and Bindler (2011) discovered that cardiorespiratory fitness mediated the relationship between motivation and weight loss. Adolescents in their study who were intrinsically motivated for physical activity were more fit and less likely to be overweight. In middle school and high school students, Springer (2013) suggested an increase in youth’s endurance level was due, in part, to increased levels of competence or exercise self-efficacy. Research has shown that increases in self-efficacy have been and continue to be associated with physical activity participation (McAuley, 1992; Sallis & Owen, 1999), thus it is important to establish exercise programs that boost self-confidence and competence among adolescents and young adults in regards to adherence. Researchers Li, Iannotti, Haynie, Perlus, and Simons-Morton (2014) studied 11th graders and their motivation towards moderate to vigorous physical activity using the self-determination theory. Consistent with research in this review, more physical activity engagement is associated with positive intrinsic motivation. Ntoumanis (2001) found that student’s level of effort was strongly predicted by intrinsic motivation in that those who found physical education exciting and fun were likely to exert high effort to learn new motor skills and
accomplish a certain level of competence. The author further stated that students who perceived themselves as highly competent were less likely to be externally motivated or amotivated in physical education and those who perceived a lack of physical competence usually found their PE experience meaningless (amotivation), and engaged in it only because it was the rule or because of a fear of punishment (external regulation). In regards to sport and competitive athletes Balaguer, Castillo, and Duda (2008) discovered that self-determined motivation predicted both self-esteem and life satisfaction.

Wilson, Mack, and Grattan (2008) demonstrated that adults satisfying psychological needs through exercise were associated with a more self-determined motivation to exercise. Such findings prompt others to conclude that intrinsic motivation for exercise might thus be cultivated by repeated exposure to exercise experiences that generate acute positive affect (Schneider & Kwan, 2013). Rodgers et al., (2010) suggested that if non-exercisers or individuals who are newcomers to participating in exercise do not develop stronger self-determined forms of regulation, they are unlikely to adhere to exercise programs, putting themselves at higher levels of health risk. The health risks that are associated with physical inactivity highlight the need for interventions that emphasize identified and intrinsic regulations in an attempt to initiate exercisers, enhance their development, and increase the probability of long-term adherence (Rodgers et al., 2010). Martín-Albo, Núñez, Domínguez, León, and Tomás (2012) found that intrinsic motivation influences physical self-concept. Wherein physical self-concept is defined as the perceptions of oneself formed through experience with and interpretations of one’s environment related to one’s physical domain (Shavelson, Hubner, & Stanton, 1976). This is significant due to the fact that Leung and Leung (1992) said that physical self-
concept has a direct and positive relationship with satisfaction of life. These findings, as well as results from Nunez, Martín-Albo, and Domínguez (2010) suggest that if an individual who participates in physical activity with self-determined motivation will, over time, develop a greater physical self-concept and this, in turn, will contribute to increased psychological well-being. Thøgersen-Ntoumani and Fox (2007) also found a pattern between intrinsic motivation and mental well-being in that engaging in exercise due to fun and enjoyment was significantly and positively associated with well-being variables.

Self-Determination, Physical Activity and College Students

When examining college students from freshman year to senior year, some researchers found no differences in physical activity over time (Calfas, Sallis, Lovato, & Campbell, 1994; Pinto, 1995; Wallace & Buckworth, 2001) whereas other studies discovered that as time goes on, physical activity declines (Caspersen, Pereira, & Curran, 2000). Researchers Bray and Kwan (2006) stated that insufficiently active students may be a group at higher risk than active students for more serious illness. These authors further explained that insufficiently active students may display individually a set of motivational characteristics showing that they are less inclined to look after themselves, and also report lower levels of psychological well-being (Bray & Kwan).

Through past research it has been shown that engaging in regular physical activity improves physiological and psychological health. Yet, according to Kilpatrick et al. (2005) epidemiological evidence suggests that the level of physical activity declines from high school to college, and activity patterns in college population are generally insufficient to improve health and fitness. In 1995, the National College Risk Behavior Survey indicated that only 38% of college students participated in regular vigorous
activity and only 20% participated in regular moderate activity (Douglas, 1997). Findings such as these highlight the need to identify factors underlying the motivational regulations of college students towards exercise. Supporting this concept Lin and Yao (2010) indicated that undergraduates showed a strong relationship between the basic psychological needs in exercise, intrinsic health motivation, exercise behavior, and the psychological domain of QoL. That said, satisfaction of the three psychological needs can enhance intrinsic motivation, empower people to take care of their health willingly which can then lead to an improved HRQoL.

Nevertheless, according to Rhodes and Fiala (2009) adherence to exercise regimes is often less than satisfactory and this serves as a reason to study physical activity motivation and behavior so that researchers can develop better programs and interventions to improve the physical activity patterns of college students (Kilpatrick et al., 2005). Not only is it important to integrate physical activity into most days of the week to gain the health benefits, it may also improve motivation towards exercising. Secondary to this Kwan and Bryan (2010) suggested that a positive affective response to exercise is prospectively associated with greater motivation to exercise and also assists in supporting motivation over time.

**Summary**

The college population may be at more risk than the general population in terms of psychological and/or mental well-being. This can be attributed to the lack of physical activity, risky behavior, and the multiple stressors that inevitably arise during the course of their time spent in academics which can lead to various forms of mental health problems. To combat mental health problems is where physical activity comes into play.
Thus, investigating aerobic fitness and its relationship with motivation and quality of life is critical in further explaining the positive impact it can have in a college setting.

If implementing aerobic fitness into college students daily routines can help develop a greater more intrinsically driven motivation, sense of self-worth, and aid in a more positive psychological well-being then it is paramount to help students adopt a more physically active lifestyle. Past research has supported this notion that the more physical activity an individual participates in it tends to lead to more favorable outcomes across the diverse domains of HRQoL and is establishing this type of behavior in college can have a long-term impact on future physical activity habits. Therefore, this research will make an important contribution to the literature on college student’s physical activity levels and its relationship with their motivation and perceived quality of life.
INTRODUCTION

Quality of life is defined as the “individuals’ perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns” (World Health Organization [WHO], 1993; 1998). The breadth of this definition includes the consideration of a number of domains which may be positively or negatively impacted and thus influence the individual’s “perception of their position”, such as: (a) physical health, (b) psychological well-being, (c) degree of independence, (d) social interactions, (e) personal beliefs, and (f) the interactive effects with the environment. The subjective nature of these appraisals mixed with cultural complexities has made quality of life a difficult construct to measure (Centers for Disease Control and Prevention [CDC], 2011). To more easily address this issue, domains are investigated individually. Of those domains which comprise quality of life, physical health continues to receive considerable attention.

Encouraging regular participation in physical activity is a worldwide public health priority (WHO, 2004) and the benefits are notable. For example, performing moderate physical activity (e.g., walking) on most days of the week (e.g., five days) decreases the risk of death from cardiovascular diseases by 30% (Leitzman et al., 2007). According to the CDC, however, the percentage of adults 18 years of age and older in the United States who met the 2008 physical activity guidelines, which are defined as 150 minutes per week of moderate-intensity or 75 minutes per week of vigorous-intensity aerobic activity along with resistance training exercise, was 48% (2012). This statistic is corroborated
with 2013 data from the Behavioral Risk Factor Surveillance System (BRFSS), which indicated that over 79% of respondents did not participate in enough aerobic and muscle strengthening exercises to meet guidelines. A nominal increase in daily physical activity would enable most American adults to improve their health and quality of life (Blair et al., 1989) as moderate-to-high levels of physical activity alleviate the negative effects associated with sedentary behavior.

**Self-Determination Theory and Physical Activity**

There are numerous reasons individuals use to justify why they do not partake in physical activity. To better understand these perceived barriers to regular physical activity, it may be helpful to examine expectancy-value theories to explain the motivation (or lack thereof) to engage in physical activity. One such theory that is derived from this approach is self-determination theory (SDT; Deci & Ryan, 1985). Self-determination theory is a multi-layered framework, which assumes an interaction among different levels. A primary level of the theory posits that satisfying the three basic psychological needs of (a) autonomy, (b) relatedness, and (c) competence influences a continuum of motivational categories. Specifically, three categories of motivation are identified as: (a) amotivation, (b) extrinsic motivation, and (c) intrinsic motivation. Along this continuum starting with extrinsic motivation and working towards intrinsic motivation, certain regulatory mechanisms can have an influence on an individual’s behavior. Moving from extrinsic towards intrinsic motivation, these behavioral regulations are: (a) external regulation, (b) introjected regulation, (c) identified regulation, and (d) integrated regulation. According to predictions from SDT, autonomous motivation should positively link with overall indices of health and well-being, such as health-related quality of life
(HRQoL), which is supportive of one’s inherent tendencies toward psychological growth, development, and overall adjustment (Ryan & Deci, 2008).

Authors Hagger and Chatzisarantis (2008) claimed that public health researchers have been particularly intrigued in the psychological influences on exercise behavior because it is believed these can be manipulated through intervention to change one’s behavior. Researchers have found that people who report more self-determined motives also report more regular physical activity including exercise, as well as more positive physical and psychological outcomes of physical activity participation (e.g., Hagger & Chatzisarantis, 2007; Landry & Solomon, 2004; Mullen & Markland, 1997; Sebire, Standage, & Vansteenkiste, 2009; Standage, Sebire, & Loney, 2008; Wilson & Rodgers, 2002; 2004; Wilson, Rodgers, Fraser, & Murray, 2004).

A secondary analysis was conducted investigating the pattern of change in the forms of self-regulation over courses of exercise and examining the differences between regular and non-regular exercisers and their level of endorsement of self-regulation.

Regular exercisers (defined as individuals who have been exercising a minimum of three times per week for a minimum of six months), whereas non-regular exercisers or initiates were defined as individuals beginning exercise who, for at least the past six months, had only exercised a maximum of once per week. Results indicated that for motivational regulation it was found that non-regular exercisers were the least self-determined and regular exercisers were the most self-determined (Rodgers et al., 2010). Another study in which perceived autonomy support by the exercise instructor, basic psychological needs, behavioral regulations, and exercise identity were assessed among exercise participants,
demonstrated that adults satisfying psychological needs through exercise were associated with a more self-determined motivation to exercise (Wilson, Mack, & Grattan, 2008).

**Self-Determination Theory and Quality of Life**

Schalock (1996) suggested that quality of life is best viewed as a unifying concept to practice to improve the life conditions of all people, and suggested that quality of life is composed of a number of core ideologies and dimensions. The eight core ideologies highlight that quality of life is important for all people and is experienced when an individual’s basic needs are met, and is improved by integration and by enabling individuals to partake in decisions that impact their lives. These results from Schalock (1996) suggest that self-determination contributes to a more positive quality of life for people with mental retardation.

**Quality of Life and Physical Activity**

Quality of life is a broad ranging concept affected in a complex way by the person's physical health, psychological state, and level of independence, social relationships, and their relationships to salient features of their environment (World Health Organization Quality of Life Group [WHOQOL], 1993). Favorable outcomes among those students who participated in a recommended dose of physical activity were more likely to have an improved HRQoL and perceived health status (Brown et al., 2003; Sundblad et al., 2008; Zahran et al., 2007). Others have identified that physical inactivity is one of the six priority health risk behaviors for college populations and yet more than ever students are adopting a sedentary lifestyle (Keating et al., 2005). Similarly, additional research found that students attending college have not engaged in an adequate amount of physical activity that is thought to promote health benefits (Biddle &
Chatzisarantis, 1999; Sundblad et al., 2008). While research continues to support the benefits of exercise and the related improvements on physical and mental health, most college students remain unperturbed and do not exercise.

Given that researchers have advocated for a greater research focus on the health of college students (Keating et al., 2005; Stewart-Brown et al., 2000), understanding this tripartite relationship may provide insight as to how to improve exercise programming with college students. Research has revealed the association’s perceived quality of life has on aerobic endurance and the association’s self-determination has on aerobic endurance, but little research has examined the relationship between aerobic endurance, specifically low recovery heart rate, and intrinsic motivation and satisfaction with overall life in a sample of college-aged participants. The purpose of this study was to explore the relationship between aerobic fitness, behavioral regulations, and perceived quality of life in a sample of college students.

METHODS

Participants

Participants were recruited from a small comprehensive college in the northeast region of the United States. A total of 218 undergraduate and graduate students (129 males, 89 females) were recruited by means of promotional fliers, in-class announcements, and word-of-mouth. Only participants that met the inclusion criteria participated in the study. Criteria for inclusion in the study were (a) enrolled as either an undergraduate or graduate student and (b) between the ages of 18-30 years. Participants were excluded if they (a) responded positively on the Physical Activity Readiness Questionnaire (PAR-Q) or (b) were an athlete on a National Collegiate Athletic
Association-sanctioned team. Fifteen participants were excluded from the study due to a positive response on the PAR-Q (14 individuals) or due to an injury (1 individual).

Descriptive statistics for the male and female participants are presented in Table 1. Table 2 provides descriptive statistics on the academic year and academic major of the participants.

Table 1. Descriptive Statistics for Participant Characteristics (N=218).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Age (yrs)</td>
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<td>1.4</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>163.8</td>
<td>6.9</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>71.1</td>
<td>65.4</td>
</tr>
</tbody>
</table>

Table 2. Descriptive Statistics for Academic Year and Academic Major of Study Participants

<table>
<thead>
<tr>
<th>Major</th>
<th>Freshman</th>
<th>Sophomore</th>
<th>Junior</th>
<th>Senior</th>
<th>Graduate</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise Science</td>
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<td>15</td>
<td>39</td>
<td>30</td>
<td>5</td>
<td>90</td>
</tr>
<tr>
<td>Physical Education</td>
<td>0</td>
<td>12</td>
<td>38</td>
<td>15</td>
<td>1</td>
<td>66</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>4</td>
<td>10</td>
<td>15</td>
<td>2</td>
<td>32</td>
</tr>
<tr>
<td>Fitness Development</td>
<td>1</td>
<td>2</td>
<td>12</td>
<td>10</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>Recreation</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3</strong></td>
<td><strong>34</strong></td>
<td><strong>101</strong></td>
<td><strong>71</strong></td>
<td><strong>9</strong></td>
<td><strong>218</strong></td>
</tr>
</tbody>
</table>

Each participant received a verbal description of the study and provided informed consent prior to participating. The study was reviewed and received approval from the college’s institutional review board.
Psychological Measures

The Behavioral Regulations in Exercise Questionnaire-2 (BREQ-2; Markland & Tobin, 2004) was administered through an online survey that was constructed from www.surveylet.com. The BREQ-2 was used to assess participants’ regulatory behaviors for exercise. The BREQ-2 consists of 19 items designed to tap an individual’s level of intrinsic motivation (e.g., “I exercise because it’s fun”), identified regulation (e.g., “I value the benefits of exercise”), introjected regulation (e.g., “I feel guilty when I don’t exercise”), external regulation (e.g., “I exercise because other people say I should”), and amotivation (e.g., “I don’t see why I should have to exercise”). The BREQ-2 is scored using a 5-point Likert-type scale ranging from 0 (Not true for me) to 4 (Very true for me).

The Perceived Quality of Life Scale (PQoL; Patrick, Danis, Southerland, & Hong, 1988; Patrick, Kinne, Engelberg, & Pearlman, 2000) was used to assess participant’s perception of their quality of life. The scale asked participants to self-report their level of satisfaction with their physical [e.g., “Your physical health (the health of your body)”], social (e.g., “How well you carry on a conversation, for example, speaking clearly, hearing others, or being understood”), and cognitive functioning (e.g., “How well you think and remember”). The PQoL consists of 19 items, each with a 10-point response scale ranging from 0 (Extremely dissatisfied) to 10 (Extremely satisfied).

Physical Measures

The Queen’s College step test was used for the prediction of aerobic capacity. Step heights were adjusted to the Queen’s College standardized step height of 41.25cm. A demonstration was first provided and then the participant practiced stepping in a step
up, step down fashion with a metronome cadence. Females had the metronome set at 88 beats \( \cdot \text{min}^{-1} \) to allow the participant to make contact with a foot on each beep in an “up-up-down-down” manner, resulting in 22 steps \( \cdot \text{min}^{-1} \). For males, the metronome was set at 96 beats \( \cdot \text{min}^{-1} \) resulting in 24 steps \( \cdot \text{min}^{-1} \). To avoid muscle fatigue, the participant was instructed to switch the leading leg at least once during the test. After three minutes of step exercise, the participant stopped and stood off to the side of the step and remained standing for one minute. After sixty seconds passed, recovery heart rate was recorded and compared with age and gender specific standardized norms (Hoffman, 2006) and used to estimate aerobic fitness (expressed as ml kg\( \cdot \text{min}^{-1} \)).

Resting and recovery heart rate were monitored using a polar heart rate system (FS2; Polar Electro Inc., Lake Success NY). Each participant was outfitted with a Polar heart rate monitor adjustable chest strap, pod, and wrist watch. In order to determine true resting heart rate, subjects were instructed to rest in a supine position on a yoga mat and quietly rest for five minutes. At the end of five minutes, resting heart rate was recorded.

Participants were shown the Borg 6-20 Ratings of Perceived Exertion (RPE) scale where they indicated their level of effort, prior to, immediately post-exercise, and at the end of recovery (i.e. min 0.00, min 3:05, and min 4:05). Participants indicated their effort level by pointing to the appropriate number of how they subjectively felt on three different occasions. Providing RPE ensured fidelity of the test and confirmed submaximal effort.

**Anthropometric Measures**

Height was taken using a standard stadiometer (Health O Meter, Continental Scale Corp., Bridgeview, IL). Participants were measured without shoes and standing
straightforward. A measuring platform was raised over a participant’s head and they were instructed to take a deep breath and step forward away from the stadiometer. Height was then recorded to the nearest tenth of a centimeter (cm). Weight was measured using a Tanita digital scale (BF522W Body Fat / Body Water Analyzer). Participants were instructed to stand on the scale without shoes but with athletic clothing. Weight was recorded to the nearest tenth of a kilogram (kg).

**Statistical Analyses**

Using a cross-sectional study, the relationship between aerobic fitness (independent variable), behavioral regulation sub scores, and perceived quality of life scores (dependent variables) were carried out. Descriptive statistics (mean ± standard deviation, or frequency) for variables of interest were computed. For statistical analysis, STATA version 13 software was used to employ a path analysis to examine the relationship between Behavioral Regulation sub-score (i.e. intrinsic regulation and identified regulation), cardiorespiratory fitness as measured by recovery heart rate and PQoL scores. A likelihood ratio chi-square was used to test the model fit. The level of significance was set at \( p \leq 0.05 \).

**RESULTS**

A total of 218 out of 233 possible subjects were analyzed, with 14 subjects being excluded for a positive response on the Physical Activity Readiness Questionnaire (PAR-Q) and one subject excluded due to injury. A positive response to the PAR-Q indicates a health concern and that the participant might not be suitable for the submaximal test.

Male and female descriptive statistics of RPE scores at the pre (0:00 min), post (3:05 min), and post recovery (4:05 min) are seen in Table 3. This table shows that
participants provided support for the intensity of the activity. Other means and standard deviations of the other variables of interest (i.e., intrinsic regulation identified regulation, perceived quality of life, recovery heart rate) can be seen in Table 4. Although insignificant, the characteristics of the PQoL scores are described as dissatisfied being a score of <7.5 and satisfied being a score of >7.5, where female mean scores resulted in 7.48 and male mean scores at 7.32. Based on the normative data for recovery heart rate (Hoffman, 2006) the values suggest that the mean scores of females resulted in average performance, whereas males mean score indicated below average performance.

The results of the likelihood ratio chi-square suggest that the model seen in figure 2 was not a good fit $\chi^2(2), p = <0.01$. It is important to note that the chi-square fit is sensitive to larger sample sizes. There were no significant relationships found between any of the variables. The results of the path analysis (Figure 2) indicate that aerobic fitness as measured by recovery heart rate was not a significant predictor of perceived quality of life. Further, in this model both intrinsic regulation and identified regulation were not significant predictors of aerobic fitness. Additionally, there was no indirect effect seen in intrinsic regulation and identified regulation on perceived quality of life scores. The total effects of the unstandardized coefficients are presented in Table 5.

Table 3. Descriptive Statistics for Ratings of Perceived Exertion (RPE)

<table>
<thead>
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<th>Variable</th>
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<th>Males</th>
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<td></td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
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<td>6.22</td>
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<tr>
<td>3:05min</td>
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<tr>
<td>4:05min</td>
<td>9.90</td>
<td>2.03</td>
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Table 4. *Descriptive Statistics for Behavioral Regulations, Perceived Quality of Life, and Aerobic Fitness Measures*

<table>
<thead>
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<tbody>
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<td></td>
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<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
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<td>.63</td>
</tr>
<tr>
<td>Intrinsic</td>
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<td>.56</td>
<td>3.44</td>
<td>.61</td>
</tr>
<tr>
<td>PQoL</td>
<td>7.48</td>
<td>1.00</td>
<td>7.32</td>
<td>1.13</td>
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<tr>
<td>Recovery HR</td>
<td>111.14</td>
<td>19.44</td>
<td>110.02</td>
<td>18.29</td>
</tr>
</tbody>
</table>

Table 5. *Test Results of All Variables*

| Total Effect | Coef. | Std. Err. | z     | P>|t|  | [95% Conf. Interval] |
|--------------|-------|-----------|-------|------|----------------------|
| Recovery HR  |       |           |       |      |                      |
| Intrinsic    | -2.270| 2.710     | -0.800| 0.402| -7.590               | 3.040               |
| Identified   | -3.370| 2.390     | -1.400| 0.159| -8.070               | 1.320               |
| PQoL         |       |           |       |      |                      |
| Recovery HR  | 0.004 | 0.004     | 1.140 | 0.254| -0.003               | 0.013               |
| Intrinsic    | -0.010| 0.012     | -0.860| 0.390| -0.036               | 0.141               |
| Identified   | -0.016| 0.018     | -0.900| 0.366| -0.052               | 0.019               |
DISCUSSION

To the best of our knowledge, this is the first study comparing the relationship between a direct measure of aerobic fitness, behavioral regulations, and perceived quality of life among college-aged adults. A sample of 218 college-aged participants completed the BREQ-2 (BREQ-2; Markland & Tobin, 2004) and PQoL (Patrick, Danis, Southerland, & Hong, 1988; Patrick, Kinne, Engelberg, & Pearlman, 2000) prior to performing the 3-min Queen’s College step test. This submaximal test was used to establish recovery heart rate, which was then entered into an estimation equation to calculate a measure of aerobic fitness (expressed as beats per min⁻¹).

Several past studies (Biddle & Chatzisarantis, 1999; Sundblad et al., 2008, Keating et al., 2005; Stewart-Brown et al., 2000) have recommended future studies to further investigate the college population to potentially determine ways to help college
students become more physically active and lead a more satisfying life. The importance from a theoretical perspective is from our results we can infer that irrespective of aerobic fitness level, there is no direct correlation to perceived quality of life among apparently healthy college-aged students. Theoretical perspectives are important because our assumptions direct our attention and provide a framework for interpreting what we observe. When we look at the practical perspective, we can conclude that the level of aerobic fitness an individual has achieved may not be the best determinant in contributing to a quality life and becoming inherently driven to engage in physical activity. This is of concern to exercise scientists, athletic trainers, personal trainers, and fitness professionals in an applicable and useful manner in that other elements under the umbrella of physical activity may be of more significance in manifesting a life of quality and getting clients to innately enjoy and value the type of fitness in which they engage.

In regards to the first research hypothesis, aerobic fitness as measured by recovery heart rate was not a significant predictor of perceived quality of life. In regards to the second research hypothesis, both intrinsic regulation and identified regulation were not significant predictors of aerobic fitness. The path analysis showed no indirect effect seen in intrinsic regulation and identified regulation on perceived quality of life. Overall, there were no significant relationships found between any of the variables with a significance level set at $\alpha \leq 0.05$.

According to the past research, our study is inconsistent with the results of our first hypothesis. Numerous studies (Imayama et al., 2013; Gordon, Wilks, & McCaw-Binns, 2013; Riess et al., 2014) have indicated the positive effect of cardiorespiratory fitness and its relation with perceived quality of life; however, a majority of these studies
were conducted in a clinical setting. Furthermore, results from our second hypothesis do not support past research and is therefore inconsistent. However, a distinguishing factor is the abundance of past studies investigated change over time as well as different training modalities (i.e., aerobic, resistance, group exercise classes, aerobic and resistance training). These past studies (Mandic et al., 2009; Tsarouhas et al., 2011) showed that a 12-week to 12-month exercise intervention resulted in positive changes in quality of life.

When comparing past literature to our findings there are similar findings that can be made, specifically in regards to results of a submaximal cardiorespiratory exercise test. A more recent study explored the relationship between cardiorespiratory fitness (CRF) and HRQoL in healthy young Navy Seal men. After conducting a modified Balke test, results suggested a positive relationship between high levels of CRF and the mental and health components of HRQoL (Sloan, Sawada, Martin, & Church, 2009). Similar to our study, we utilized a submaximal exercise test, specifically the Queen’s College step test, to assess cardiorespiratory fitness. Although mean scores for either gender were high, females scored average and males scored below average and, thus, a high quality of life was not seen. This stands to reason that to some degree, the more aerobically fit an individual is might potentially lead to favorable outcomes in the HRQoL domain.

However, a major difference in design is most studies were conducted over an extended period of time, whereas our study was a one-time visit which may, in part, explain why the results our study found were not comparable with others. One study administered a 12-week exercise intervention with heart failure patients and the effect of different training modalities on exercise capacity, systolic function, muscular strength and endurance, and quality of life. When comparing training of aerobic and combined
aerobic and resistance training for 12-weeks, only the aerobic group’s quality of life improved (Mandic et al., 2009). Another study examined a 12-week unsupervised 40 minute walking program that was performed five days per week. This training exhibited a marked heart rate recovery improvement and an associated improvement in perceived quality of life in chronic heart failure patients, mainly due to the physical improvements (Tsarouhas et al., 2011).

Similarly, in 2014, a study tested if exercise training improves aerobic capacity, muscle strength, and quality of life in renal transplant recipients. The outcome showed that over a 12-week span of supervised endurance and strength training improved peak exercise aerobic capacity and cardiac output, muscle strength, and QoL in clinically stable renal transplant recipients (Riess et al., 2014). One year prior, Imayama and colleagues (2013) conducted a 12-month exercise intervention on healthy adults. This study investigated improvements in exercise adherence, self-efficacy, and HRQoL through changes in cardiopulmonary fitness and anthropometric measurements. The exercise intervention included six days per week at sixty minutes of moderate-to-vigorous (60%-85% HR$_{\text{max}}$) of aerobic exercise. Results indicated monitoring adherence and tailoring exercise programs to induce changes in cardiopulmonary fitness and body composition may lead to greater improvements in HRQoL and self-efficacy that could promote exercise maintenance. Yet again in 2013, Gordon and colleagues studied the effects of aerobic training on functional status and HRQoL in chronic stroke survivors. This 12-week walking program also showed improvements in the physical health component of HRQoL and endurance in persons with chronic stroke.
It is noteworthy to mention that the plethora of exercise interventions that have previously been done were designed for physical activity in regards to resistance training. Moreover, many of these past studies have not looked solely into aerobic fitness as a means of predicting motivation to engage in physical activity and perceived quality of life. Additionally, past studies have largely focused on clinical populations as opposed to college-aged and apparently healthy. The present study has advanced literature in the college realm, explicitly the link between aerobic fitness, behavioral regulations that drive human behavior, and the quality of life student’s face.

Limitations

There are a few limitations from this study that need to be mentioned. The population targeted for our study may not have adequately represented a convenient sample of college-aged students attending a small comprehensive university. A larger and more diverse sample size that included a wider range of students majoring in different programs may have warranted different results. Another limitation is only one measure of physical fitness was being measured, specifically a submaximal aerobic exercise test. A more appropriate means of fitness level could have been determined through various other exercise tests that may have included body composition, muscular strength, and flexibility.

In respect to the measurement tools that were used, the Behavioral Regulations in Exercise Questionnaire-2 (BREQ-2) is designed to determine the level of motivation (i.e., amotivation, extrinsic motivation, and intrinsic motivation) a person has to engage in physical activity. This type of questionnaire only represents the motivation that drives human behavior; it does not represent the three basic psychological needs of the self-
determination theory. An alternative questionnaire that targets the three psychological needs of autonomy, competence, and relatedness may have shown different results. Research has supported that if all three psychological needs are being met then it is more likely that individual will be intrinsically motivated, thus ensuring clients adhering to an exercise program because they inherently enjoy the activities they are participating in.

The second measurement tool, the Perceived Quality of Life (PQoL) scale, is a measure based on a model defining quality of life as evaluation of major categories of fundamental life needs (Patrick, 2015). Originally, the PQoL was used in a shorter 12-item version for assessing the quality of life of persons following intensive care (Patrick et al., 1988). It was later expanded to 19 items to include areas of functional status considered important to persons with varying levels of wellness and disability; however it has been most widely used in populations with chronic conditions (Patrick, 2015). Thus, the questions asked about physical, social, and cognitive aspects of one’s life may not have been appropriate for college students as they were not originally designed for that type of population.

Although, no significance was shown in the current study, it is important to further understand what could be potential reasons why no significance was seen that may have been due to the type of questionnaires used, exercise test chosen, and participants were recruited along with the type of educational background those subjects were coming from.

**Future Research Recommendations**

Self-determination theory and quality of life are both complex in their understanding and application among various groups of people. To begin to grasp both
concepts, researchers should attempt to focus on other factors that may contribute in a more significant and meaningful way to life satisfaction and motivation to partake in physical activity.

Specifically, in regards to the self-determination theory, perhaps being more concerned with the needs satisfaction of the self-determination theory would yield greater insight. Past research has revealed other determinants to be predictive of intrinsic motivation as it relates to engaging in physical activity. Working with the framework of the self-determination theory, authors Deci and Ryan (1985) have proposed the concept that individuals possess three primary psychological needs and satisfying these needs can lead to improvements in intrinsic or identified motivation. Deci and Ryan (1985) argued that the relative influence of each psychological mediator will vary depending on the practical significance of the situation. If in a given scenario perceptions of competence are more appropriate and important, then perceptions of competence will have a greater impact on motivation. These three primary needs are capable of accounting for why some people might enjoy exercise while others avoid it, thus for fitness professionals this could be of benefit when attempting to modify their client’s exercise behavior. In order to foster a more internalized behavior towards physical activity, fitness professionals should aim to enhance an individual’s sense of autonomy, competence, and relatedness that are conducted in a positive, mutually supportive environment wherein satisfying social interactions can occur.

Another recommendation to investigate further is heredity; several studies (Lortie et al., 1982; Montoye & Gayle 1978; Moore-Harrison & Lightfoot 2010) have highlighted the importance of genetic differences and exercise training. If both training
and genetics are important, which element is more influential for given components of fitness? The maximal oxygen uptake (VO$_2$max) limit is the result of the combined efficiency of the cardiovascular, respiratory, and musculoskeletal systems; together they determine a particular ability to capture, transport, and use oxygen (Costa et al., 2013). Past research has suggested a significant inheritance of approximately 40% (Lortie et al., 1982; Montoye & Gayle 1978), and more recently researchers have proposed that genetic factors could be responsible for upwards of 50% of the variance in aerobic performance (Bouchard et al., 1998; Pérusse et al., 2001). This evidence from both twin and family studies has shed light on the role of heredity and its strong genetic influence on aerobic endurance. According to Moore-Harrison and Lightfoot (2010), when the genetic regulators of physical activity are recognized, this information could significantly impact health promotion strategies focused on increasing physical activity levels and decreasing the epidemic of obesity. Knowledge of the genetic mechanisms linked with physical activity levels could lead to individualized programs and behavior change strategies designed for those subject to being inactive. This will aid in an increase in physical activity levels, which in turn will lead to increases quality of life (Moore-Harrison & Lightfoot, 2010).

Future research should explore better possible predictors of quality of life and the level of motivation by means of the type of physical activity one participates in. Different types of physical activity or styles of exercise may contribute in a greater way to quality of life and the type of behavioral regulation within the theory of self-determination. In 2009, Ryan, Williams, Patrick, and Deci noted an indecisiveness and lack of motivation that people have to commit to physical activity. These researchers explained one possible
reason for this may be that people may not be sufficiently interested in exercise, or value its outcomes enough to make it a priority in their life. In further support, Deci and Ryan (1985) stated that finding enjoyment for exercise is important in that it is associated with intrinsic motivation. Intrinsic motivation refers to performing an activity for the pleasure and satisfaction it provides, thus it stands to reason that if enjoyment can be increased and consequently intrinsic motivation, it may result in an individual's increased desire to exercise. By offering a wide range of activities people are more apt to freely choose what is interesting to them. Couple that with the use of knowledgeable professionals providing pertinent and applicable information while being in a supportive environment that is encouraging people will be more likely to adopt and maintain an active lifestyle (Booth, Bauman, Owen, & Gore, 1997).

These approaches could identify underlying responses that may differ among genetics and different types of exercise, giving fitness professionals the opportunity to create better exercise programs that will ensure clients achieving a quality life and enhancing the level of intrinsic motivation they have for physical activity.

Conclusion

Aerobic fitness as measured by a submaximal three minute step test for recovery heart rate is not a significant predictor of intrinsic regulation or identified regulation as measured by the BREQ-2. Thus, incorporating aerobic fitness into an exercise program will not predict a self-determined form of motivation.

Aerobic fitness as measured by a submaximal three minute step test for recovery heart rate is not a significant predictor of perceived quality of life in college-aged
students as measured by the PQoL. Consequently, adding aerobic fitness into an exercise program will not predict a better perceived quality of life.

Motivational regulations: intrinsic and identified regulation did not show a significant relationship between PQoL scores in college-aged students, suggesting that these variables are independent of one another.

ACKNOWLEDGEMENTS

The authors wish to acknowledge Anna Platz, Allen Kryger, Andrew Branca, and Kyle Evanetski for their assistance with data collection.
References


Fairey, A., Courneya, K., Field, C., Bell, G., Jones, L., & Mackey, J. (2005). Randomized controlled trial of exercise training in postmenopausal breast cancer survivors:


Mandic, S., Tymchak, W., Kim, D., Daub, B., Quinney, H., Taylor, D., … Haykowsky, M. (2009). Effects of aerobic or aerobic and resistance training on cardiorespiratory


APPENDIX A: Institutional Review Board Approval Letter

MEMORANDUM

To: Alanna Darling, Erik Lind
From: Jena Curtis, Chair
       Institutional Review Board
Date: 1/20/2015
Re: Institutional Review Board Approval

In accordance with SUNY Cortland’s procedures for human research participant protections, the protocol referenced below has been approved for a period of one year:

Title of the study: Aerobic Endurance and the Relationship with Self-Determination Theory and Quality of Life Measures.

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<th>Level of review:</th>
<th>Expedited</th>
<th>Protocol number:</th>
<th>14510</th>
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<tr>
<td>Project start date:</td>
<td>Upon IRB approval</td>
<td>Approval expiration date*:</td>
<td>1/19/2016</td>
</tr>
</tbody>
</table>

* Note: Please include the protocol expiration date to the bottom of your consent form and recruitment materials. For more information about continuation policies and procedures, visit www.cortland.edu/irb/Applications/continuations.html.

The federal Office for Research Protections (OHRP) emphasizes the necessity of investigators in protecting the rights and welfare of human subjects and are responsible for carrying out ethical research consistent with IRB plan approval. Along with meeting the specific requirements of a particular research study, investigators are responsible for ongoing requirements in the conduct of approved research that include:

- obtaining and documenting informed consent from the participants and/or from a legally authorized representative prior to the individuals’ participation in the research, unless these requirements have been waived by the IRB;
- obtaining prior approval from the IRB for any modifications of (or additions to) the previously approved research; this includes modifications to advertisements and other recruitment materials, changes to the informed consent or child assent, the study design and procedures, addition of research staff or student assistants, etc. (except those alterations necessary to eliminate apparent immediate hazards to subjects, which are then to be reported by email to irb@cottland.edu within three days);
- providing to the IRB prompt reports of any unanticipated problems involving risks to subjects or others;
- notifying the IRB of continued research under the approved protocol to keep the records active; and,
- maintaining records as required by the HHS regulations and NYS State law, for at least three years after completion of the study.

Miller Building, Room 402 • P.O. Box 2000 • Cortland, NY 13045-0900
Phone: (607) 753-1511 • Fax: (607) 753-5590
In the event that questions or concerns arise about research at SUNY Cortland, please contact the IRB by email irb@cortland.edu or by telephone at (607)753-2511. You may also contact a member of the IRB who possesses expertise in your discipline or methodology, visit http://www.cortland.edu/irb/members.html to obtain a current list of IRB members.

Sincerely,

[Signature]

Jena Curtis, Chair
Institutional Review Board
SUNY Cortland
APPENDIX B: Informed Consent

Title of Study: Aerobic Endurance and the influence on Motivation and Life Quality.

Investigators:
Alanna Darling, B.S.
Graduate Student C-108 Van Hoesen Hall
Kinesiology Department
State University of New York at Cortland
Cortland, NY 13045
Tel. (607) 753-4814
E-mail: alanna.darling@cortland.edu

This is a research study. Please take your time in deciding if you would like to partake. Please feel welcome to ask questions at any time.

INTRODUCTION
The purpose of this study is to examine how an individual’s level of motivation and perceived quality of life is related to their level of aerobic fitness. You are being invited to participate in this study because we are investigating particular physical and psychological responses in a representative sample from a healthy college-aged adult (18 to 30 years old) population.

RESPONSIBILITIES OF THE PARTICIPANT
Information you possess about your health status or previous experiences of heart-related symptoms (e.g., shortness of breath with low-level activity, pain, pressure, tightness, heaviness in the chest, neck, jack, back, and/or arms) with physical effort may affect the safety of your exercise test. Your prompt reporting of these and any other unusual feelings with effort during the exercise test itself is very important. You are responsible for fully disclosing your medical history, as well as symptoms that may occur during the test. You are also expected to report all medications (including non-prescription) taken recently and, in particular, those taken today, to the testing staff.

DESCRIPTION OF PROCEDURES
If you agree to participate in this study, your participation will last the duration of one visit to a campus fitness facility (Group Fitness Room, Student Life Center on the SUNY-Cortland campus). Before the test, the Research Assistants will distribute IPads for you to record your responses to internet-based surveys. Upon completion of the IPad surveys, you will be instructed by the Researcher to start the exercise test. For this one time visit, you will perform an aerobic endurance exercise test using a 16.25 inch bench stepping to the beat of a metronome, which will be set at a specific cadence. This is a test that will determine your cardiorespiratory or aerobic endurance fitness. The cadence of the metronome will be adjusted according to sex. Both males and females are to step using a four-step cadence, ‘up-up-down-down’ for 3 minutes. Research Assistants may stop the test at any time because of changes in stepping cadence capability. It is important
for you to realize that you may stop when you wish because of feelings of fatigue or any other discomfort. Immediately after 3 minutes of stepping, you will be asked to remain standing while a 60 second recovery heart rate is measured using the heart rate monitor. Your pulse, which is the rate at which your heart beats, will be taken from the heart rate watch you will be wearing on your right wrist for 60 seconds. The 60 second pulse reading from the heart rate watch will determine your recovery heart rate. Recovery heart rate is the rate at which the heart rate returns to baseline after a period of exercise and will be used to estimate your aerobic capacity. This test is expected to last a total of 25 minutes with 5 to 10 minutes allotted to questionnaires, 10 minutes for instructions and 3 minutes assigned to physical effort. Once your recovery heart rate has been recorded on the IPad, you are free to leave.

During your one visit, the Research Assistants will ask you twice throughout 3-minute step test to indicate how you feel by using simple rating scales. Your answer will be recorded on the IPad. You may skip any question that you do not wish to answer or that makes you feel uncomfortable. This one visit is expected to last approximately 25 minutes.

**RISKS**
Participating in a 3-minute step test may result in physical sensations that you usually experience during your normal training program. Because of the nature of the assessment, a level of exertion is required. This exertion can cause temporary changes that include moderate increases in blood pressure, fast or slow heart rhythm, changes in breathing, fainting, and soreness in the active muscles that are engaged in the assessments. These effects should not last long. For example, your heart rate and breathing should return to normal shortly after exercise is over and any soreness in the working muscles should not last more than a day or two. Every effort will be made to minimize these risks by evaluation of preliminary information relating to your health and fitness and by careful observation during the testing. Emergency equipment and trained personnel are available to deal with unusual situations that may arise.

**BENEFITS**
If you decide to participate in this study there will be a direct benefit to you: you will receive a free fitness assessment and your results will help determine your present level of cardiorespiratory fitness. It is also hoped that the information gained in this study will benefit science by providing valuable information on the patterns of physiological, psychological, and performance-related responses to a 3-minute step test and the relation to measures of motivation and perceived quality of life. Understanding the underlying relationships may help in developing exercise programming that will enhance the quality of life for college students.

**COST AND COMPENSATION**
You will not incur any costs for participating in this study, nor will you receive any type of compensation for partaking in this study.
PARTICIPANT RIGHTS
Your participation in this study is completely voluntary and you may refuse to participate or leave the study at any time. If you decide not to participate in this study or leave the study early, it will not result in any penalty or loss of benefits to which you are otherwise entitled.

CONFIDENTIALITY
Records identifying participants will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, federal government regulatory agencies (the National Institutes of Health) and the Institutional Review Board (a committee that reviews and approves human subject research studies) may inspect and/or copy your records for quality assurance and data analysis. These records may contain private information. The ensure confidentiality to the extent permitted by law, your name and other identifying information will be permanently erased once the collected data have been tabulated and entered in a computer for statistical analysis. Thus, there will be no traceable connection between your name and your data. Until the data are tabulated, your records will be kept in a room that will be locked at all times and only the Researchers will have access to it. If the results are published, your identity will remain confidential.

INQUIRIES OR PROBLEMS
Any questions about the procedures used in the exercise test or the results of your test are encouraged. If you have any concerns or questions, please ask testing staff for further explanations. For further information about the study, contact Alanna Darling (C-108 Van Hoesen Hall, 607-753-4814, alanna.darling@cortland.edu. If you have any questions about the rights of research subjects or research-related injury, please contact the IRB Administrator, Miller Bldg, Rm 402, PO Box 2000, Cortland, NY 13045, (607) 753-2511; IRB@cortland.edu

PARTICIPANT SIGNATURE
Your signature indicates that you voluntarily agree to participate in this study, that the study has been explained to you, that you have been given the time to read the document and that your questions have been satisfactorily answered. You will receive a copy of the written informed consent prior to your participation in the study.
Participant’s Name (printed)
(Participant’s Signature) (Date)

INVESTIGATOR STATEMENT
I certify that the participant has been given adequate time to read and learn about the study and all of their questions have been answered. It is my opinion that the participant understands the purpose, risks, benefits and the procedures that will be followed in this study and has voluntarily agreed to participate.
PARTICIPANT SIGNATURE

Your signature indicates that you voluntarily agree to participate in this study, that the study has been explained to you, that you have been given the time to read the document and that your questions have been satisfactorily answered. You will receive a copy of the written informed consent prior to your participation in the study.

Participant’s Name (printed) _____________________________________________

_________________________________________  _________________
( Participant’s Signature)                              (Date)

INVESTIGATOR STATEMENT

I certify that the participant has been given adequate time to read and learn about the study and all of their questions have been answered. It is my opinion that the participant understands the purpose, risks, benefits and the procedures that will be followed in this study and has voluntarily agreed to participate.

_________________________________________  _________________
(Signature of Person Obtaining Informed Consent)                              (Date)

SUNY Cortland IRB
Approval Date: 1/20/2015
Expiration Date: 1/19/2016

Protocol number: M158
Approval expiration date: 1/19/2016
APPENDIX C: Demographic and Physical Activity Readiness Questionnaire (PAR-Q)

Demographic Information

Name: ___________________________ Sex: Male___ Female___
Ethnicity: ___________________________ Age: ______
Height: ___(ft)___(in) Weight: ___(lbs) Phone: (___) - ___
E-mail address: ___________________________

Physical Activity Readiness Questionnaire (PAR-Q)

For most people physical activity should not pose any problem or hazard. PAR-Q has been designed to identify the small number of adults for whom physical activity might be inappropriate or those who should have medical advice concerning the type of activity most suitable for them. Common sense is your best guide in answering these few questions. Please read them carefully and check yes or no opposite the question if it applies to you.

YES NO

____ ____ 1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?

____ ____ 2. Do you feel pain in your chest when you do physical activity?

____ ____ 3. In the past month, have you had chest pain when you were not doing physical activity?

____ ____ 4. Do you lose your balance because of dizziness or do you ever lose consciousness?

____ ____ 5. Do you have a bone or joint problem that could be made worse by a change in your physical activity?

____ ____ 6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?

____ ____ 7. Do you know of any other reason why you should not do physical activity?

SUNY Cortland IRB
Approval Date: 1/20/2015
Expiration Date: 1/19/2016

Protocol number: 141518
Approval expiration date*: 1/19/2016
APPENDIX D: Behavioral Regulations in Exercise Questionnaire-2 (BREQ-2)

EXERCISE REGULATIONS QUESTIONNAIRE (BREQ-2)

Age: ___________ years  Sex:  male  female (please circle)

WHY DO YOU ENGAGE IN EXERCISE?

We are interested in the reasons underlying peoples’ decisions to engage, or not engage in physical exercise. Using the scale below, please indicate to what extent each of the following items is true for you. Please note that there are no right or wrong answers and no trick questions. We simply want to know how you personally feel about exercise. Your responses will be held in confidence and only used for our research purposes.

<table>
<thead>
<tr>
<th></th>
<th>Not true for me</th>
<th>Sometimes true for me</th>
<th>Very true for me</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I exercise because other people say I should</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>I feel guilty when I don’t exercise</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>I value the benefits of exercise</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>I exercise because it’s fun</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>I don’t see why I should have to exercise</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>I take part in exercise because my friends/family/partner say I should</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>I feel ashamed when I miss an exercise session</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>It’s important to me to exercise regularly</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>I can’t see why I should bother exercising</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not true for me</td>
<td>Sometimes true for me</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>----------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>10</td>
<td>I enjoy my exercise sessions</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>I exercise because others will not be pleased with me if I don’t</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>I don’t see the point in exercising</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>I feel like a failure when I haven’t exercised in a while</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>I think it is important to make the effort to exercise regularly</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td>I find exercise a pleasurable activity</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>I feel under pressure from my friends/family to exercise</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>17</td>
<td>I get restless if I don’t exercise regularly</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>I get pleasure and satisfaction from participating in exercise</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>19</td>
<td>I think exercising is a waste of time</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Thank you for taking part in our research.
APPENDIX E: Perceived Quality of Life (PQoL) Scale

Satisfaction with Health and Life

We would like to know how satisfied you are with different aspects of your life. Each item below has a scale where “0” is Extremely Dissatisfied and “10” is Extremely Satisfied. [For each item, mark an [ ] in the box of the number that shows your own level of satisfaction.]

How dissatisfied or satisfied are you with:

1. Your physical health (the health of your body)?

2. How well you care for yourself, for example, preparing meals, bathing, or shopping?

3. How well you think and remember?

(Please turn the page)
How dissatisfied or satisfied are you with:

4. The amount of walking you do?

5. How often you get outside the house, for example, going into town, using public transportation or driving?

6. How well you carry on a conversation, for example, speaking clearly, hearing others, or being understood?

7. The kind and amount of food you eat?

(Please turn the page)
8. How often you see or talk to your family and friends?

9. The help you get from your family and friends, for example, helping in an emergency, fixing your house, or doing errands?

10. The help you give to your family and friends?

11. Your contribution to your community, for example, a neighborhood, religious, political or other group?

(Please turn the page)

How dissatisfied or satisfied are you with:
12. Your retirement or current job?

<table>
<thead>
<tr>
<th>Extremely dissatisfied</th>
<th>Extremely satisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
</tbody>
</table>

13. The kind and amount of recreation or leisure you have?

<table>
<thead>
<tr>
<th>Extremely dissatisfied</th>
<th>Extremely satisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
</tbody>
</table>

14. Your level of sexual activity or lack of sexual activity?

<table>
<thead>
<tr>
<th>Extremely dissatisfied</th>
<th>Extremely satisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
</tbody>
</table>

15. The way your income meets your needs?

<table>
<thead>
<tr>
<th>Extremely dissatisfied</th>
<th>Extremely satisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
</tbody>
</table>

(Please turn the page)
How dissatisfied or satisfied are you with:

16. How respected you are by others?

How satisfied

17. The meaning and purpose of your life?

How satisfied

18. The amount of variety in your life?

How satisfied

19. The amount and kind of deep you get?

How satisfied

(Please turn the page)

20. How happy are you?

How happy
APPENDIX F: Ratings of Perceived Exertion Scale (RPE)

**RATING OF PERCEIVED EXERTION**

Instructions: During the exercise bout, we want you to pay close attention to how hard you feel the exercise work rate is. This feeling should reflect your total amount of exertion and fatigue, combining all sensations and feelings of physical stress, effort, and fatigue. Don’t concern yourself with any one factor, such as leg pain, shortness of breath or exercise intensity, but try to concentrate on your total, inner feeling of exertion. Try not to underestimate or overestimate your feeling of exertion; be as accurate as you can.

<table>
<thead>
<tr>
<th>Heart Rate</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>No exertion at all</td>
</tr>
<tr>
<td>7</td>
<td>Very, very light</td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Very light</td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Fairly light</td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Somewhat hard</td>
</tr>
<tr>
<td>14</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Hard</td>
</tr>
<tr>
<td>16</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Very hard</td>
</tr>
<tr>
<td>18</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Very, very hard</td>
</tr>
<tr>
<td>20</td>
<td>Maximal exertion</td>
</tr>
</tbody>
</table>

Borg (1970)
APPENDIX G: Male Normative Values

Normative values for males for recovery heart rate following the 3-minute step test (beats min⁻¹).

<table>
<thead>
<tr>
<th>Age (Y)</th>
<th>18-25</th>
<th>26-35</th>
<th>36-45</th>
<th>46-55</th>
<th>56-65</th>
<th>66+</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MALES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>70-78</td>
<td>73-79</td>
<td>72-81</td>
<td>78-84</td>
<td>72-82</td>
<td>72-86</td>
</tr>
<tr>
<td>Good</td>
<td>82-88</td>
<td>83-88</td>
<td>86-94</td>
<td>89-96</td>
<td>89-97</td>
<td>89-95</td>
</tr>
<tr>
<td>Above Average</td>
<td>91-97</td>
<td>91-97</td>
<td>98-102</td>
<td>99-103</td>
<td>98-101</td>
<td>97-102</td>
</tr>
<tr>
<td>Average</td>
<td>101-104</td>
<td>101-106</td>
<td>105-111</td>
<td>109-115</td>
<td>105-111</td>
<td>104-113</td>
</tr>
<tr>
<td>Below Average</td>
<td>107-114</td>
<td>109-116</td>
<td>113-118</td>
<td>118-121</td>
<td>113-118</td>
<td>114-119</td>
</tr>
<tr>
<td>Poor</td>
<td>118-126</td>
<td>119-126</td>
<td>120-128</td>
<td>124-130</td>
<td>122-128</td>
<td>122-128</td>
</tr>
<tr>
<td>Very Poor</td>
<td>131-164</td>
<td>130-164</td>
<td>132-168</td>
<td>135-158</td>
<td>131-150</td>
<td>133-152</td>
</tr>
</tbody>
</table>

APPENDIX H: Female Normative Values

Normative values for females for recovery heart rate following the 3-minute step test (beats min\(^{-1}\)).

<table>
<thead>
<tr>
<th>AGE (Y)</th>
<th>18-25</th>
<th>26-35</th>
<th>36-45</th>
<th>46-55</th>
<th>56-65</th>
<th>66+</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FEMALES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXCELLENT</td>
<td>72-83</td>
<td>72-86</td>
<td>74-87</td>
<td>76-93</td>
<td>74-92</td>
<td>73-86</td>
</tr>
<tr>
<td>GOOD</td>
<td>88-97</td>
<td>91-97</td>
<td>93-101</td>
<td>96-102</td>
<td>97-103</td>
<td>93-100</td>
</tr>
<tr>
<td>ABOVE AVERAGE</td>
<td>100-106</td>
<td>103-110</td>
<td>104-109</td>
<td>106-113</td>
<td>106-111</td>
<td>104-114</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>110-116</td>
<td>112-118</td>
<td>111-117</td>
<td>117-120</td>
<td>113-117</td>
<td>117-121</td>
</tr>
<tr>
<td>BELOW AVERAGE</td>
<td>118-124</td>
<td>121-127</td>
<td>120-127</td>
<td>121-126</td>
<td>119-127</td>
<td>123-127</td>
</tr>
<tr>
<td>POOR</td>
<td>128-137</td>
<td>129-135</td>
<td>130-138</td>
<td>127-133</td>
<td>129-136</td>
<td>129-134</td>
</tr>
<tr>
<td>VERY POOR</td>
<td>142-155</td>
<td>141-154</td>
<td>143-152</td>
<td>138-152</td>
<td>142-151</td>
<td>135-151</td>
</tr>
</tbody>
</table>