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## A Study of Grit in the CrossFit Population

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# **A Study of Grit in the CrossFit Population**

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A Doctoral Research Project

submitted to

The College of Psychology and Liberal Arts

School of Psychology

Florida Institute of Technology

Melbourne, Florida

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In Partial Fulfillment

of the Requirements for the Degree

Doctor of Psychology

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by

Cierra Carter, M.S.

February, 2020

We the undersigned committee hereby approve the attached doctoral research project in partial fulfillment for the degree of Doctor of Clinical Psychology.

A Study of Grit in the CrossFit Population

By

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## **Abstract**

### A Study of Grit in the CrossFit Population

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Exercise has extensively shown to provide both physical and mental health benefits. CrossFit is one type of exercise program, and although the workouts can be strenuous, it has continued to increase in popularity since its inception in 2001. Grit has been defined as “unyielding courage in the face of hardship or danger” (Merriam-Webster.com, 2019, definition of grit [entry 1 of 2], para. 4). Duckworth et al. (2007) developed a valid and reliable 12-item measure of grit – the Grit Scale. Duckworth and Quinn (2009) later adapted the original Grit Scale (Grit-O) to be a briefer and more efficient version, which they named the Short Grit Scale (Grit-S). Research on the topic of grit and research with the CrossFit population are relatively new concepts and, consequently, studies on these areas are rather limited. The purpose of this study is to contribute to the existing research on CrossFit and the Short Grit Scale (Grit-S). The objectives of this study are to examine the levels of grit in CrossFit participants compared to non-CrossFit participants and to evaluate factors (i.e., demographic and exercise behavior information) that influence grit levels. It was hypothesized that grit scores would be higher in CrossFit participants compared to those who do not participate in CrossFit. Independent samples *t*-tests were conducted and the results were not statistically significant. Therefore, the hypothesis was not supported. Explanations for this finding are offered.

Keywords: Grit-S, CrossFit, exercise

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## **Review of Literature**

### **What is Exercise?**

"Physical fitness," "physical activity," and "exercise" are terms often used interchangeably, but encompass different concepts (Caspersen, Powell, & Christenson, 1985). Physical fitness can be defined as “a set of attributes that are either health or skill related” (Caspersen et al., 1985, p. 126). Physical activity is "behavior that drives 'human movement'...[and], in turn, results in change in physiological attributes such as greater 'energy expenditure' and improved 'physical fitness'" (Diana, 2012, p.2). Physical activity can also be classified as various activities, such as sports, household, or occupational (Caspersen et al., 1985).

While physical activity and exercise include common factors, exercise is considered a specific form of physical activity (Caspersen et al., 1985). Caspersen et al. (1985) define exercise as “physical activity that is planned, structured, repetitive, and purposive in the sense that improvement or maintenance of one or more components of physical fitness is an objective” (p. 128). The Merriam-Webster dictionary defines exercise as “bodily exertion for the sake of developing and maintaining physical fitness” (Definition of exercise [entry 1 of 2], para. 2b). Paillard, Rolland, and de Souto Barreto (2015) define physical exercise as “repetitive and purposeful physical activity generally used to improve physiological, physical, and functional capacities.

### **History of Exercise**

Exercise is a concept that has existed for many centuries in many cultures. Yoga, a practice focusing on mind and body control, was practiced in India as early as 3300

B.C. (History of Health and Fitness, 2019). Ancient philosophers in India believed Yoga, which is a combination of breathing patterns and physical positions, supported overall well-being and organ functioning (Dalleck & Kravitz, 2002). In Persia, individuals utilized calisthenics, weight training, and wrestling as early as the fourth and fifth centuries A.D (History of Health and Fitness, 2019). As early as 2500-250 B.C. in China, Confucius's philosophical teachings recommended exercise to prevent certain diseases (Dalleck & Kravitz, 2002). Physical activities in ancient China included Cong Fu gymnastics, wrestling, fencing, and dancing (Wuest & Bucher, 1995).

In Ancient Greece in 2500-200 B.C., physical perfection was an ideal that encouraged young boys to participate in gymnastics, wrestling, and running (Dalleck & Kravitz, 2002). In Sparta specifically, boys began extensive fitness programs at age seven to increase the efficiency of their warrior abilities, while females were also expected to participate in athletic activity (Health and Fitness History, 2019). In 200 B.C. – 476 A.D. in the Roman Empire, because all citizens between ages 17-60 could be drafted into the military, they had to sustain adequate physical condition (Dalleck & Kravitz, 2002). Consequently, military training in the Roman Empire included javelin and discus throwing, jumping, and running (Grant, 1964).

During the Dark and Middle Ages, the lifestyle of barbaric tribes included hunting and cattle tending, so exercise was required in order to survive (Randers-Pehrson, 1993). During the Renaissance, the emphasis of physical fitness from the ancient Greek standards re-emerged, in conjunction with the belief that high fitness abilities increased intellectual ability (Hay, 1986; Hale, 1994). Consequently, physical education was



developed to promote exercise in school (Dalleck & Kravitz, 2002). Since then, gymnastics popularity increased throughout Europe (Dalleck & Kravitz, 2002).

During the period from 1776-1860 in the United States, early Presidents, such as Benjamin Franklin and Thomas Jefferson, continued to emphasize the importance of fitness and exercise through swimming, running, and basic resistance training (Dalleck & Kravitz, 2002). Additionally, during this time Catherine Beecher developed a fitness program for women, which was similar to modern-day aerobics (Barrow & Brown, 1988). In the post-Civil War era from 1865-1900, changes from rural to urban life and labor-intensive jobs to mechanical and industrial technology decreased physical activity levels (Dalleck & Kravitz, 2002). During World War I, a discovery that one third of individuals drafted were unfit for combat motivated the government to improve physical education in schools (Wuest & Bucher, 1995; Barrow & Brown, 1988). However, the exercise levels again decreased during the Roaring Twenties and Great Depression due to a focus on entertainment (Dalleck & Kravitz, 2002). After World War II, the discovery that almost half of the individuals drafted were unfit for combat again led the United States to recognize again the importance of fitness (Rice, Hutchinson, & Lee, 1958).

During the 1940s, Dr. Thomas Cureton conducted research that led to recommendations for flexibility, muscular strength, and cardiorespiratory endurance, and became the foundation for exercise regimens in the future (Dalleck & Kravitz, 2002). In the 1950s Jack LaLanne, a media fitness trainer who is now viewed as a key influencer of fitness, developed fitness regimens for aerobics and resistance exercise as well as the exercise equipment that is still used today, such as the cable-pulley, Smith, and leg

extension machines (Dalleck & Kravitz, 2002). In 1956, President Dwight D. Eisenhower created the President's Council on Youth Fitness. During the 1960s, President John F. Kennedy promoted exercise through fitness programs, and Dr. Ken Cooper, often known as "The Father of the Modern Fitness Movement," promoted disease prevention through exercise (Dalleck & Kravitz, 2002). In 1972, the Presidential Sports Award was created to encourage Americans to regularly engage in physical activity (President's Council on Sports, Fitness & Nutrition, 2019). In the 1960s, the President's Council on Youth Fitness's name was changed to the President's Council on Physical Fitness and Sports, and the name was again changed in 2010 to the President's Council on Sports, Fitness, and Nutrition. Despite the name changes, this council has worked to encourage Americans to engage in active and healthy lifestyles since its development (President's Council on Sports, Fitness & Nutrition, 2019).

Currently, the United States Department of Health and Human Services (HHS, 2018), provides guidelines for physical activity engagement. Though physical activity is recommended for everyone, the rates vary for children, adolescents, older adults, pregnant and postpartum women, adults with chronic health conditions, and adults with disabilities (HHS, 2018). The original 2008 guidelines for physical activity recommended adults participate in a minimum of "150 minutes (2 hours and 30 minutes) per week of moderate-intensity, or 75 minutes (1 hour and 15 minutes) per week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic activity" for significant health rewards (p. vii). They specify that aerobic exercise should be completed in occurrences of a minimum of 10 minutes, and ideally

distributed throughout the week. In addition to recommendations for aerobic exercise, they provide recommendations to engage in “muscle-strengthening activities that are moderate or high intensity and involve all major muscle groups on 2 or more days a week” for added health rewards (p. vii).

The HHS guidelines were updated in 2018 and note that adults can acquire added benefits by engaging in moderate-intensity exercise at an increased frequency and/or duration. They also added an ideal time range as follows:

At least 150 minutes (2 hours and 30 minutes) to 300 minutes (5 hours) a week of moderate-intensity, or 75 minutes (1 hour and 15 minutes) to 150 minutes (2 hours and 30 minutes) a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic activity.

(p. 8)

The Centers for Disease Control and Prevention (CDC, 2017) collected data from a sample of the civilian noninstitutionalized population in 1998, 2000, 2010, 2015, and 2016. They found trends from 1998 to 2016 that the percentage of people who met the guidelines for both muscle-strengthening and aerobic activity involvement gradually increased, while the percentage of people who met neither of these guidelines gradually decreased over these years. Specifically, in 2016, 22.7% of people met the guidelines for both muscle-strengthening and aerobic activity involvement, whereas 43.8% of people met neither of these guidelines.

## **Benefits of Exercise**

According to the Centers for Disease Control and Prevention (2018), the top 10 leading causes of death in the United States are cardiovascular disease, cancer, unintentional injuries, chronic lower respiratory diseases, stroke, Alzheimer's disease, diabetes, influenza and pneumonia, kidney disease, and suicide. Thus, it was quite noteworthy when exercise was found to play a role in the prevention, development, and/or effects of these issues.

Cardiovascular disease is the leading cause of death in the United States (CDC, 2018). Hu et al. (2004) found that the risk of mortality due to cardiovascular disease doubled in women who were physically inactive when compared to those who were active. In men, increased fitness is associated with a significant decrease in the risk of cardiovascular disease (Myers et al., 2004). High blood pressure and diabetes are factors that increase the risk of cardiovascular disease, while increased levels of high-density lipoprotein cholesterol decrease the risk of cardiovascular disease (CDC, 2019). Relatedly, exercise can assist in decreasing hypertension (Leitao, Leitao, & Louro, 2017) and the risk of stroke (Sacco et al., 2006). Exercise can also increase high-density lipoprotein cholesterol (Durstine et al., 2002). Additionally, exercise, in combination with other factors such as dietary alterations, has been shown to be effective in reducing the incidence of type two diabetes (Schellenberg et al., 2013).

With respect to less obvious diseases, Lee (2003) found correlations between increased physical activity and lower risk of developing colon cancer, breast cancer, and lung cancer. Pechter et al. (2003) found exercise improved conditions of patients with

moderate kidney failure. Covey and Larson (2004) found that patients with chronic obstructive pulmonary disease reported a decrease in breathing difficulty and fatigue after completing an exercise regimen. Baumann et al. (2012) found that the risk of developing pneumonia was higher in leukemia patients who did not participate in an exercise program. Related to unintentional injuries, exercise programs appear to be effective in preventing falls and injuries caused by falls in older adults (El-Khoury et al., 2013).

According to Paillard et al. (2015), physical activity can play a role in delaying the onset of dementia and Alzheimer's Disease in older adults. Moreover, data support the hypothesis of a correlation between increased physical activity and reduced risk of developing Alzheimer's Disease (Hamer & Chida, 2009). Additionally, patients with dementia have reported fewer symptoms of depression when involved in exercise regimens (Williams & Tappen, 2008). Relatedly, support has been found for the association between increased amount of physical activity throughout life and decreased risk of developing Parkinson's Disease (Xu et al., 2010). Furthermore, associations have been found between increased physical activity and the ability for patients with Parkinson's Disease to maintain their psychomotor learning abilities, enhance fall prevention, and improve balance, walking speed, and muscle strength (Paillard et al., 2015).

Suicide is the 10<sup>th</sup> leading cause of death in the United States (CDC, 2018). Associations have been found between suicidal ideation, depression, and anxiety (May, Klonsky, & Klein, 2012). However, regular exercise is associated with decreased depression and anxiety (De Moor et al., 2006). Relatedly, exercise has been shown to

have other positive effects on mental health. Physical activity has been associated with improved quality of life (Penedo & Dahn, 2005) and mental well-being (Windle et al., 2010; Zubala et al., 2017). Hassmen, Koivula, and Uutela (2000) found that those who exercised daily reported lower levels of stress compared to those who did engage in any exercise. Associations have also been found between increased physical activity and increased self-esteem (Sani et al., 2016). Additionally, exercise has been associated with hardiness, a personality characteristic that allows to persevere through distressing circumstances (Weinberg & Gould, 2015). Furthermore, exercise has been found to be positively correlated with attention and working memory (Hotting & Roder, 2013).

### **Types of Exercise**

Exercise has typically been divided into two categories: aerobic and anaerobic. The goal of aerobic exercise is to improve pulmonary and cardiovascular structures by engaging in continuous movements to increase one's rate of respiration (Fondow, Emery, & Emery, 2006)). Some examples of aerobic exercise include running a marathon or swimming for one hour. The goal of anaerobic exercise is to maintain a healthy skeletal system, as well as increase muscle quantity (Fondow et al., 2006). This is generally done by engaging in strength training movements for a shorter period of time when compared to aerobic exercise. Some examples of anaerobic exercises include weightlifting (i.e., clean and snatch) and powerlifting (i.e., back squat, deadlift, and bench press), as well as utilizing isolation exercises (e.g., bicep curl, tricep extension, leg press, leg curl, etc.).

In recent years, focus on exercise intensity has become an increased trend. Thompson (2018) identified high-intensity interval training (HIIT) as a high contender on

a list of Top 20 Worldwide Fitness Trends for 2019. There are two main types of high-intensity exercise: high-intensity interval training (HIIT) and high-intensity functional training (HIFT). While there are similarities between these two types, there are also significant differences. HIFT can be defined as “a training style [or program] that incorporates a variety of functional movements, performed at high-intensity [relative to an individual’s ability], and designed to improve parameters of general physical fitness (e.g., cardiovascular endurance, strength, body composition, flexibility, etc.) and performance (e.g., agility, speed, power, strength, etc.)” (Feito, Heinrich, Butcher, & Poston, 2018, p. 2).

In addition to high-intensity interval training, Thompson (2018) also identified group training and functional fitness training on a list of Top 20 Worldwide Fitness Trends for 2019. CrossFit is an exercise methodology that utilizes all of these characteristics. Moreover, CrossFit’s popularity has exponentially increased over the years, ranging from the opening of the original CrossFit gym in 2001 to 10,000 affiliate gyms in June of 2014 (Beers, 2014).

### **What is CrossFit?**

CrossFit is an evidence-based fitness model with the prescription of “constantly varied, high-intensity, functional movement” (Glassman, 2007, p. 1). Functional movements are defined as multi-joint, or compound, movements that require contraction from core to extremity (Glassman, 2007). This means that the movement patterns utilized in CrossFit exercises can be translated across different settings in everyday life. In addition to functional movements, another key component in CrossFit is intensity or

power, which is considered to be the ability to quickly move an amount of mass over a certain distance (Glassman, 2007). Furthermore, CrossFit incorporates both aerobic and anaerobic movements (Gianzina & Kassotaki, 2019). CrossFit specifically identifies 10 general physical skills, including accuracy, agility, balance, cardiovascular/respiratory endurance, coordination, flexibility, power, speed, stamina, and strength (CrossFit, Inc., 2017). The goal of CrossFit is to not only increase fitness but to prepare individuals for any possible physical task, from a young adult wanting to perform better in a collegiate sport to an elderly adult wanting to maintain the ability to perform activities of daily living independently. For example, a collegiate volleyball player may want to improve his or her vertical jump, while an elderly adult may want to be able to independently and safely lift and carry a bag of dog food into his/her home.

### **Characteristics of CrossFitters**

Research on CrossFit, in general, is relatively limited, and the research on characteristics of CrossFitters is even more slim. Among the available research, some studies have found no associations related to CrossFit. Koteles, Kollsete, & Kollsete (2016) found no association was found between CrossFit workouts and psychological functioning, including self-esteem, body awareness, body image satisfaction, affect, and well-being. Similarly, Eather, Morgan, and Lubans (2016) found no association was found between CrossFit participation and improved mental health outcomes, such as self-esteem and perceived appearance.

Though some studies have not found any correlations related to CrossFit, many studies have found positive associations between CrossFit participants and various



characteristics. CrossFit coaches appear to believe that participants experience both psychological and physical positive results (Heinrich, Carlisle, Kehler, & Cosgrove, 2017). Feito, Brown, Box, Heinrich, and Petruzzello (2018) found that CrossFit participants who trained more often reported higher levels of challenge, strength and endurance, and social recognition. Relatedly, Heinrich, Patel, O'Neal, and Heinrich (2014) found that participants in CrossFit workouts were more likely to maintain adherence and enjoyment in their training.

Some research has been conducted to examine the motivating factors behind CrossFit participation. Davies et al. (2016) found that CrossFit participants appear to be motivated by intrinsic reasons to attend sessions rather than by their monetary investment. Relatedly, Sibley and Bergman (2017) found a positive association between intrinsic goals and psychological need satisfaction in CrossFitters. They further found that health management and skill development are the main goals CrossFitters want to achieve (Sibley & Bergman, 2017). Partridge, Knapp, and Massengale (2014) found that more self-improvement goals were reported among CrossFit participants who reported being members for a shorter time. One study examined gender differences related to motivation for CrossFit participation. The researchers found that men appear to have more goals related to performance compared to others, while women appear have more goals related to self-improvement (Partridge, Knapp, & Massengale, 2014).

Despite the evidence for positive associations related to CrossFit participation, many people are intimidated by the thought of participating in CrossFit due to the perceived difficulty. Drum, Bellovary, Jensen, and Donath (2016) found that CrossFit

participants had higher ratings of intensity, more hard days per week, and participants were expected to perform at their personal best each session. CrossFit participants also had increased “feelings of excessive fatigue, muscle soreness, muscle swelling, shortness of breath, muscle pain to light touch, and limited movement in muscles used during exercise within 48-hours post-exercise” (Drum et al., 2016, p. 8). Although CrossFit workouts can be strenuous, participation in CrossFit has continued to grow. Moreover, Hawkins (2016) found correlations between better CrossFit performance and a variety of factors, including increased coping skills, increased openness to coaching, increased achievement motivation and confidence, increased goal setting and mental preparation, and an increased tendency to welcome pressure situations.

## **Grit**

In the Merriam-Webster dictionary, grit is defined as “firmness of mind or spirit: unyielding courage in the face of hardship or danger” (Definition of grit [entry 1 of 2], para. 4). Sturman and Zappala-Piemme (2017) established the following definition of grit: “To sustain a focused effort to achieve success in a task, regardless of the challenges that present themselves, and the ability to overcome setbacks.” (p. 2). Duckworth, Peterson, Matthews, and Kelly (2007) define grit as “perseverance and passion for long term goals” (p. 1087). Duckworth et al. (2007) view grit as “working strenuously toward challenges, maintaining effort and interest over years despite failure, adversity, and plateaus in progress” (p. 1088). They further state, “The gritty individual approaches achievement as a marathon; his or her advantage is stamina. Whereas disappointment or

boredom signals to others that it is time to change trajectory and cut losses, the gritty individual stays the course” (p. 1088).

## **Grit Measures**

### **Development and Validation Efforts of the Grit Scale.**

Duckworth et al. (2007) developed and validated a self-report grit measure, the Grit Scale. They generated 27 items associated with the construct of grit and which seemed to be face valid across adult and adolescent populations. The items did not identify a specific life domain. The items are rated on a five-point Likert scale. After reviewing the items and conducting a factor analysis, the 27 items were reduced to 12 items related to perseverance of effort and interest consistency over time. They determined the internal consistency level for these items was high for the overall scale ( $\alpha = .85$ ), the Consistency of Interests factor ( $\alpha = .84$ ), and the Perseverance of Effort factor ( $\alpha = .78$ ).

Duckworth et al. (2007) assessed the predictive validity of the grit measure by examining its correlation with higher education in adults who were at least 25 years old. The grit measure, along with questions pertaining to participant age and education, were posted online and 1,545 participants completed it. They conducted a two-way analysis of variance and found that individuals with more education had higher grit scores compared to individuals who were the same age but had less education.

Duckworth et al. (2007) conducted another study to control for the Big Five personality traits to determine if the findings related to grit and education would remain the same. The grit scale and demographic questions in addition to the Big Five Inventory

(BFI) and another question (“the number of times I have changed careers”) were completed by 706 participants. They found grit was more associated with Conscientiousness ( $r = .77, p < .001$ ) than to the other Big Five factors (Openness to Experience,  $r = .14, p < .001$ ; Extraversion,  $r = .22, p < .001$ ; Agreeableness,  $r = .24, p < .001$ ; Neuroticism,  $r = -.38, p < .001$ ). Their results supported the incremental predictive validity of grit for age ( $F(4, 682) = 15.32, p < .001, \eta^2_p = .08$ ) and education ( $F(3, 682) = 11.54, p < .001, \eta^2_p = .05$ ) beyond the Big Five factors. Education ( $F(3, 657) = 10.63, p < .001, \eta^2_p = .05$ ) and age ( $F(4, 657) = 8.45, p < .001, \eta^2_p = .05$ ) continued to be significant predictors of grit when conscientiousness was included as a covariate. Additionally, their results supported the incremental predictive validity of grit for number of lifetime career changes more so than age or the Big Five factors. They also conducted a binary logistic regression to predict low versus high career change from the Big Five factors, age, and grit. Among these, they found that grit was the only significant predictor ( $OR = 0.65, \beta = -.44, p = .001$ ).

Duckworth et al. (2007) conducted another study to assess for a correlation between grade point average (GPA) and grit. Additionally, SAT scores were used as a measure of general mental ability. The grit scale and demographic information were completed online by 139 undergraduate students. They found an association between grit and higher GPAs ( $r = .25, p < .01$ ), but this association was stronger ( $r = .34, p < .001$ ) when SAT scores were held constant. However, an association was also found between lower SAT scores ( $r = -.20, p < .03$ ) and higher levels of grit, suggesting that among

comparatively bright individuals, individuals with lower intelligence work more determinately and harder to compensate for the discrepancy.

Duckworth et al. (2007) conducted an additional study to examine the association between grit and cadet retention in the summer program in the United States Military Academy, West Point. They also examined the association between grit and the cadets' academic GPA, military performance, and a composite score (Whole Candidate Score) based on a physical exercise evaluation, participation in extracurricular activities, SAT score, and high school rank. Participants were 1218 freshman cadets who completed the grit measure and the Brief Self-Control Scale. Duckworth et al. (2007) conducted separate binary logistic regression analyses. They found no association between grit and the Whole Candidate Score ( $r = .02, ns$ ). They did find an association between grit and self-control ( $r = .63, p < .001$ ). Furthermore, they found that compared to other predictors (Whole Candidate Score,  $\beta = .11, OR = 1.11, ns$ ; self-control ( $\beta = .12, OR = 1.13, ns$ ) grit ( $\beta = .12, OR = 1.13, ns$ ) was the best predictor of cadet completion of the summer training program. Military performance was predicted about the same by grit ( $r = .19, p < .001$ ) and self-control ( $r = .21, p < .001$ ), but better by Whole Candidate Score ( $r = .42, p < .001$ ). Grit ( $r = .06, p < .05$ ) did not predict GPA as well as self-control ( $r = .13, p < .001$ ) or Whole Candidate Score ( $r = .64, p < .001$ ).

Duckworth et al. (2007) conducted a final study to examine the association between grit and extraordinary extracurricular achievement, in addition to the expectation that time on task would mediate the effect of grit on the final round reached in a spelling bee program. Participants were 175 finalists in the Scripps National Spelling Bee in 2005.

Of those participants, 79 opted to participate in verbal IQ testing via telephone as well as complete the Grit Scale, and the Brief Self-Control Scale. Also reported were the time spent studying, the number of rounds completed in the final round of the spelling bee, and the number of times an individual participated in the final competition. In order to determine the effect of the predictors, Duckworth et al. (2007) conducted ordinal regression models. They found that age ( $\beta = .28$ , OR = 1.32,  $p < .05$ ) and grit ( $\beta = .34$ , OR = 1.41,  $p < .04$ ) predicted further advancement in the competition. When age was controlled for, self-control ( $\beta = .04$ , OR = 1.04, *ns*) did not predict performance. In an ordinal regression model using grit, age, and verbal IQ to predict final round, grit ( $\beta = .19$ , OR = 1.21, *ns*) did not predict final round. They found that finalists with less grit were outperformed by their peers with more grit, as they studied less.

The Grit-O requires a reading level equivalent to 7<sup>th</sup> or 8<sup>th</sup> grade (Sturman & Zappala-Piemme, 2017). It appears to be available in languages other than English, such as German (Fleckenstein, Schmidt, & Moller, 2014), whereas the Grit-S scale also appears to be available in German (Schmidt, Fleckenstein, Retelsdorf, Eskreis-Winkler, and Moller, 2017) as well as Spanish (Fernandez-Martin, Arco-Tirado, & Soriano-Ruiz, 2018) and Turkish (Haktanir, Lenz, Can, & Watson, 2016).

### **Development and Validation of the Grit-S Scale.**

Duckworth and Quinn (2009) attempted to develop a briefer and more efficient measure of grit – the Short Grit Scale (Grit-S). Using the original data from the Duckworth et al. (2007) study, Duckworth and Quinn (2009) conducted item-level correlations and deleted four items (two items from the Perseverance of Effort subscale

and two items from the Consistency of Interest subscale) that fell below the median in predicting an outcome. The resultant version of the Grit-S demonstrated adequate internal consistency ( $\alpha = .73 - .83$ ).

Duckworth and Quinn (2009) then conducted a second study with 1,554 participants at least age 25 who completed an online survey including demographic questions, the BFI, and the Grit-O and Grit-S items. Results showed a strong correlation between Grit-O and Grit-S scores ( $r = .96, p < .001$ ). The entirety of the Grit-S as well as the two subscales demonstrated acceptable internal consistency,  $\alpha_s = .82$  (Grit-S),  $.77$  (Consistency of Interest factor), and  $.70$  (Perseverance of Effort factor). Additionally, they determined the Grit-S had a higher correlation with BFI Conscientiousness ( $r = .77, p < .001$ ) than with the other BFI factors (Openness to Experience,  $r = .06, p = .03$ ; Extraversion,  $r = .20, p < .001$ ; Agreeableness,  $r = .24, p < .001$ ; and Neuroticism,  $r = -.40, p < .001$ ). They determined the Grit-S was a significant predictor of educational attainment using both ordinal logistic regression models ( $B = 0.21$ , odds ratio [OR] =  $1.23, p < .001$ ) and hierarchical ordinal logistic regression ( $B = 0.27$ , OR =  $1.31, p < .001$ ). They also found a significant association between Grit-S results and age ( $r = .19, p < .001$ ), but not gender ( $t[1552] = 1.50, p = .13, d = .10$ ), suggesting an increase in life experience may increase levels of grit. Finally, they found fewer career changes were predicted by Grit-S scores ( $B = 0.22$ , OR =  $0.80, p = .01$ ).

Duckworth and Quinn (2009) conducted a third study to validate a Grit-S informant report version. Participants included 161 individuals at least age 25 who completed a self-report version, in addition to nominating a family member and a friend

to complete the online informant version. They determined internal consistency for Grit-S scores by self ( $\alpha = .83$ ), peers ( $\alpha = .83$ ), and family ( $\alpha = .84$ ). They found adequate correlations between the self-report and informant versions completed by peers ( $r = .47, p < .001$ ) and family ( $r = .45, p < .001$ ). There was also an adequate correlation between family and peers ( $r = .37, p < .001$ ).

Duckworth and Quinn (2009) conducted a fourth study to determine the test-retest stability in high-achieving students. Participants included 45% of middle and high school students at a magnet public school completed the Grit-S items in the spring of 2006 and 2007. Data was also collected regarding GPA and number of hours per day spent watching television. They found an acceptable correlation between these Grit-S scores ( $r = .68, p < .001$ ) as well as adequate internal consistency for both years (2006,  $\alpha = .82$ ; 2007,  $\alpha = .84$ ). Furthermore, the Grit-S scores predicted GPA and inversely predicted television hours per day.

Duckworth and Quinn (2009) conducted a fifth study to examine Grit-S as a prediction of West Point cadet retention. Participants included 1,248 freshman cadets. They conducted a hierarchical binary logistic regression and found that compared to the Whole Candidate Score, Grit-S scores better predicted program retention ( $B = 0.69, OR = 1.00, p < .001$ ).

Finally, Duckworth and Quinn (2009) conducted a sixth study to examine the predictive validity of the Grit-S and achievement in a spelling bee. Participants included 190 spelling bee finalists who completed the Grit-S, BFI, demographic information



including spelling habits. Using ordinal logistic regression models, they found Grit-S results predicted final round attainment ( $B = 0.32$ ,  $OR = 1.38$ ,  $p = .04$ ).

### **Other Grit Measures.**

As mentioned previously, Duckworth and Quinn (2009) developed and validated the Short Grit Scale (Grit-S). This reduced the original Grit Scale (Grit-O) from 12 items to eight items, while maintaining its Likert style format and its self-report nature.

Sturman and Zappala-Piemme (2017) developed a grit measure, the Grit Scale for Children and Adults (GCSA), that can be utilized with both youth and adults. The GCSA requires a reading level equivalent to 4<sup>th</sup> or 5<sup>th</sup> grade. This questionnaire has 12 items utilizing Likert style responses and is a self-report measure. Clark and Malecki (2019) developed the Academic Grit Scale (AGS) to be utilized with youth and assess grit specifically related to academic achievement. The AGS utilizes 10 items with Likert scale responses and is a self-report measure.

### **Grit in Certain Populations**

Research on grit levels related to exercise is also limited. However, Cosgrove, Brown, Beddoes, Bartholomew, and Castelli (2016) found that grit was higher in female than male students as well as in high school than middle school students. Cosgrove et al. (2016) also found that grit levels were higher in students who participated in traditional physical education classes compared to students who participated in alternative physical education classes, such as running club. Similarly, Meyer, Markgraf, and Gnacinski (2017) found that grit levels were higher in NCAA Division I athletes compared to NCAA Division II athletes. Tedesqui and Young (2018) found that grit was the greatest

influential factor on athlete practice and commitment. Relatedly, Larkin, O'Connor, and Williams (2016) found that soccer players with higher levels of grit acquired greater time in soccer-related activities, such as training and competition. Reed (2014) found that grit scores were higher in exercisers compared to those who did not exercise. Finally, Cazayoux and DeBeliso (2019) found that advanced CrossFit athletes exhibited higher levels of grit compared to novice CrossFit athletes.

### **Statement of Purpose and Hypothesis**

The purpose of this current study is to contribute to the existing research on CrossFit as well as the Short Grit Scale (Grit-S). Specifically, the aim of this study is to examine the levels of grit in CrossFit participants. It is hypothesized that grit scores will be higher in CrossFit participants compared to those who do not participate in CrossFit.

## Method

### Participants

The participants in this study included adults aged 18 and older. Participants were asked to partake in this study on a voluntary basis, and had the option of discontinuing their participation at any given time. Participants were obtained through social media outlets and word of mouth.

Of the 424 total participants, 13 participants were not included as they did not complete the entire survey. Of the 411 resulting participants, 316 reported participating in CrossFit, 80 reported participating in other forms of exercise, and 15 reported engaging in no exercise. Gender was reported as male ( $n = 171$ ) or female ( $n = 240$ ). Age was reported in the following increments: 18 to 29 years ( $n = 84$ ), 30 to 39 years ( $n = 110$ ), 40 to 49 years ( $n = 105$ ), 50 to 59 years ( $n = 80$ ), 60 to 69 years ( $n = 28$ ), and 70+ years ( $n = 4$ ). Ethnicity was reported as follows: African American or Caribbean American ( $n = 6$ ), American Indian or Alaskan Native ( $n = 1$ ), Asian ( $n = 7$ ), Caucasian ( $n = 369$ ), Hispanic or Latino ( $n = 15$ ), Native Hawaiian or Other Pacific Islander ( $n = 2$ ), Multiple ( $n = 10$ ), and prefer not to say ( $n = 1$ ).

Participants reported how long they have been participating in CrossFit as follows: less than 6 months ( $n = 7$ ), 6 months to 1 year ( $n = 12$ ), 1 to 3 years ( $n = 117$ ), 4 to 6 years ( $n = 110$ ), 7 to 9 years ( $n = 45$ ), and more than 9 years ( $n = 25$ ). Participants reported how often they participate in CrossFit as follows: one time per year ( $n = 1$ ), one time per month ( $n = 2$ ), one time every other week ( $n = 3$ ), one day per week ( $n = 4$ ), 2 to 3 days per week ( $n = 75$ ), 4 to 6 days per week ( $n = 213$ ), and daily ( $n = 18$ ). Participants

reported how many hours per day they participate in CrossFit as follows: less than 1 hour per day ( $n = 42$ ), 1 to 2 hours per day ( $n = 265$ ), 3 to 4 hours per day ( $n = 7$ ), and more than 5 hours per day ( $n = 1$ ). Participants reported what format of CrossFit they participate in as follows: individual/by yourself ( $n = 38$ ), group/in a class and/or with others ( $n = 229$ ), and equal participation in individual and group ( $n = 49$ ).

Participants reported how often they participate in exercise as follows: one time per month ( $n = 3$ ), one time every other week ( $n = 1$ ), one day per week ( $n = 9$ ), 2 to 3 days per week ( $n = 41$ ), 4 to 6 days per week ( $n = 19$ ), and daily ( $n = 7$ ). Participants reported how many hours per day they participate in exercise as follows: less than 1 hour per day ( $n = 28$ ), 1 to 2 hours per day ( $n = 51$ ), and 3 to 4 hours per day ( $n = 1$ ).

Participants reported what format of exercise they participate in as follows: individual/by yourself ( $n = 50$ ), group/in a class and/or with others ( $n = 13$ ), and equal participation in individual and group ( $n = 17$ ).

## Measures

This study utilized the Grit-S and demographic items. The Grit-S items were answered using a five-point Likert scale (very much like me, mostly like me, somewhat like me, not much like me, not like me at all). The demographic questions included information regarding age, gender, race/ethnicity, and the following questions:

- Do you participate in CrossFit?
  - If yes:
    - How long have you been participating in CrossFit?
    - How do you most often participate in CrossFit?

- How often do you typically participate in CrossFit?
- How many hours per day do you typically participate in CrossFit?
- Do you exercise outside of CrossFit?
  - What type of other exercise do you participate in most often?
  - What format of other exercise do you participate in most often?
  - How often do you typically participate in that form of exercise?
  - How many hours per day do you typically participate in that form of exercise?
- If no:
  - Do you exercise?
    - If yes:
      - What type of exercise do you participate in most often?
      - What format of exercise do you participate in most often?
      - How often do you typically participate in that form of exercise?
      - How many hours per day do you typically participate in that form of exercise?

## **Procedure**

Approval from the Florida Institute of Technology Institutional Review Board (IRB) was obtained prior to participant recruitment. Participants were asked to complete an online survey including demographic questions and the Grit-S items. Informed consent was obtained on the first page of the survey prior to study enrollment. Participant names were not collected as part of this study. The information collected was entered into a HIPAA-compliant database and all personally identifying information was de-identified with minimal risk of breaching confidentiality.

Data were collected via an online survey, which was published using the Qualtrics software program. This survey was available through FIT's partnership with Qualtrics, and the survey was maintained on the Qualtrics website. The first page of the survey provided a description of the survey along with the informed consent.

## **Data Analyses**

Data were analyzed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics including means, standard deviations, and frequencies were calculated for demographic variable and Grit-S scores. Analyses consisted of analysis of variance (ANOVA) and *t*-tests were conducted to examine the relationship between grit scores of CrossFit participants versus non-CrossFit participants.

## Results

A one-way ANOVA was conducted to examine the effect of CrossFit participation, other exercise participation, and no exercise participation on grit scores. The assumption of homogeneity of variances was met (Levene's statistic = .142,  $p = .868$ ). ANOVA results showed that there is no overall significant mean difference among the group means of exercise participation type,  $F(2, 408) = 2.74, p = .066$ .

Due to the small sample size, participants who reported no engagement in exercise were not included in other data analyses. An independent-samples  $t$ -test was performed to examine if participants who engaged in CrossFit had higher levels of grit than participants who engaged in other forms of exercise. Assumption tests suggested that there were no outliers in the grit scores for participants, and grit was normally distributed for participants. Levene's test suggested that variances in grit for CrossFit and exercise participants were statistically equivalent,  $F(394) = .277, p = .599$ . Results from 411 participants (316 CrossFitters, 80 exercisers) showed that CrossFitters ( $M = 29.66, SD = 4.34$ ) and exercisers ( $M = 29.79, SD = 4.56$ ) were not significantly different on the level of grit,  $t(394) = -.224, p = .82$ , with the difference having a 95% CI [-1.20, .96]. Therefore, the hypothesis that those who participate in CrossFit would have a higher level of grit than those who participate in other forms of exercise was not supported.

An independent-samples  $t$ -test was performed to examine if grit levels were higher in males or females. Levene's test suggested that variances in grit for males and females were statistically equivalent,  $F(409) = .33, p = .57$ . Results from 411 participants (171 males, 240 females) showed that males ( $M = 29.80, SD = 4.29$ ) and females ( $M =$



29.45,  $SD = 4.49$ ) were not statistically different on the level of grit,  $t(409) = .793, p = .43$ , with the difference having a 95% CI [-.52, 1.22].

A one-way ANOVA was conducted to examine the effect of age on grit scores. The assumption of homogeneity of variances was met (Levene's statistic = .845,  $p = .518$ ). ANOVA results showed that there is no overall significant mean difference among the group means of age,  $F(5, 405) = 1.93, p = .088$ .

A one-way ANOVA was conducted to examine the effect of ethnicity on grit scores. The assumption of homogeneity of variances was met (Levene's statistic = 2.00,  $p = .078$ ). ANOVA results showed that there is no overall significant mean difference among the group means of ethnicity,  $F(7, 403) = .796, p = .591$ .

A one-way ANOVA was conducted to examine the effect of length of CrossFit participation on grit scores. The assumption of homogeneity of variances was met (Levene's statistic = .976,  $p = .432$ ). ANOVA results showed that there is no overall significant mean difference among the group means of length of participation,  $F(5, 310) = 1.17, p = .33$ .

A one-way ANOVA was conducted to examine the effect of CrossFit participation frequency on grit scores. The assumption of homogeneity of variances was met (Levene's statistic = 1.46,  $p = .20$ ). ANOVA results showed that there is an overall significant mean difference among the group means of CrossFit participation frequency,  $F(6, 309) = 2.33, p = .033$ . Post hoc tests were not performed for this analysis because at least one group had fewer than two cases.

A one-way ANOVA was conducted to examine the effect of CrossFit participation time per day on grit scores. The assumption of homogeneity of variances was met (Levene's statistic = .110,  $p = .896$ ). ANOVA results showed that there is no overall significant mean difference among the group means of CrossFit participation time per day,  $F(3, 311) = 2.03, p = .11$ .

A one-way ANOVA was conducted to examine the effect of CrossFit participation format on grit scores. The assumption of homogeneity of variances was met (Levene's statistic = .908,  $p = .404$ ). ANOVA results showed that there is no overall significant mean difference among the group means of CrossFit participation format,  $F(2, 313) = .592, p = .554$ .

A one-way ANOVA was conducted to examine the effect of exercise participation format on grit scores. The assumption of homogeneity of variances was met (Levene's statistic = .241,  $p = .786$ ). ANOVA results showed that there is no overall significant mean difference among the group means of exercise participation format,  $F(2, 77) = .67, p = .51$ .

A one-way ANOVA was conducted to examine the effect of exercise participation frequency on grit scores. The assumption of homogeneity of variances was met (Levene's statistic = 1.638,  $p = .174$ ). ANOVA results showed that there is no overall significant mean difference among the group means of exercise participation frequency,  $F(5, 74) = 2.156, p = .068$ .

A one-way ANOVA was conducted to examine the effect of exercise participation time on grit scores. The assumption of homogeneity of variances was not

met (Levene's statistic = 7.137,  $p = .009$ ). ANOVA results showed that there is no overall significant mean difference among the group means of exercise participation time,  $F(2, 77) = .96, p = .39$ .

Given the large discrepancy between sample sizes, a random sample of 80 CrossFitters was taken from the overall sample of 316 CrossFitters. Another independent-samples  $t$ -test was performed to examine if participants who engaged in CrossFit had higher levels of grit than participants who engaged in other forms of exercise.

Assumption tests suggested that there were no outliers in the grit scores for participants, and grit was normally distributed for participants. Levene's test suggested that variances in grit for CrossFit and exercise participants were statistically equivalent,  $F(158) = 1.067, p = .303$ . Results from 160 participants (80 CrossFitters, 80 exercisers) showed that CrossFitters ( $M = 30.20, SD = 4.17$ ) and exercisers ( $M = 29.79, SD = 4.56$ ) were again not significantly different on the level of grit,  $t(158) = .598, p = .551$ , with the difference to have a 95% CI [-.95, 1.78]. The hypothesis that those who participate in CrossFit have a higher level of grit than those who participate in other forms of exercise was still unsupported.

## Discussion

This study sought to examine the levels of grit in those who participate in CrossFit, those who participate in other forms of exercise, and those who do not participate in any exercise. However, due to the small sample size of non-exercisers, this group was not included in analyses. To study this, independent samples *t*-tests were conducted, but the results were not statistically significant. Consequently, the hypothesis that those who participate in CrossFit would have higher grit scores than the other participant groups was not supported.

Reed et al. (2014) found grit to be higher in exercisers compared to non-exercisers. However, this relationship was unable to be examined in this study due to the small sample size of non-exercisers. Additionally, Cosgrove et al. (2016) found grit to be higher in female than male students; however, this study found no statistically significant difference between male and female grit scores. Furthermore, Cazayoux and DeBeliso (2019) found that grit scores were higher in advanced CrossFit athletes compared to novice CrossFit athletes. Relatedly, it would be expected that grit scores would be higher for CrossFit participants who have engaged in these activities for a longer period of time. However, the one-way ANOVA conducted to examine the effect of length of CrossFit participation on grit scores was not statistically significant.

There were several limitations to this study. One limitation was a small sample size of exercisers and non-exercisers. No compensation was offered for participation, which could have led people to choose not to participate. Feito et al. (2018) found higher levels of social recognition among CrossFit participants. This could be a possible factor

for the high participation rate amongst CrossFitters. Another limitation could be the time of year. Data was collected in December and January. People frequently make New Year's Resolutions to participate in exercise (Norcross, Mrykalo, & Blagys, 2002). Consequently, this could have led people to answer more favorably towards exercise participation even if they do not truly regularly exercise.

Though exercise has various known benefits and the United States Department of Health and Human Services (HHS, 2018) provides guidelines and recommendations for everyone to participate in a minimum level of exercise, many people do not follow these guidelines (CDC, 2017). Heinrich et al. (2014) found that those who participate in CrossFit are more likely to maintain adherence to training. Additionally, Hawkins (2016) found a correlation between CrossFit participation and increased coping skills and confidence. One potential future study would be to duplicate this study, but with closer sample sizes among groups. If results of a similar future study were found to be significant, further future research could be conducted to screen for grit in mental health patients who struggle to adhere to exercise regimens and assess if CrossFit participation enhances adherence and related treatment outcomes.

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## **Appendix: Participant Informed Consent Form**

### **Informed Consent**

**Please read this consent document carefully before you decide to participate in this study. The researcher will answer any questions before you sign this form.**

#### **Study Title: CrossFit and Grit**

**Purpose of the Study:** Exercise has various physical and psychological benefits. Associations have been found between grit levels and exercise. CrossFit is an increasingly popular method of exercise. The aim of this study is to contribute to the existing research on the Short Grit Scale and CrossFit.

**Procedures:** Participation will involve completing a survey that includes questions about non-identifying demographic information (e.g., age, gender, race/ethnicity) and exercise behaviors. Participants will also be asked to answer items on the Short Grit Scale. Participants may complete the survey even if they do not exercise or do not participate in CrossFit. The study should take you less than 10 minutes to complete.

**Potential Risks of Participating:** The risks of participating in this study are minimal. Risks of participating will be no more than what is expected in everyday life, as the participants will be completing anonymous self-report surveys. However, participants will be asked questions about exercise behaviors which they may find stressful.

**Potential Benefits of Participating:** Research on the topic of grit and research with the CrossFit population are relatively new concepts and, consequently, research on these areas are limited. If the results are significant, future research could be conducted to screen for grit in mental health patients who struggle to adhere to exercise regimens and assess if CrossFit participation enhances adherence and related treatment outcomes.

**Compensation:** Compensation will not be provided for participation in this study.

**Confidentiality:** Participation will be anonymous. Your identity will be kept confidential to the extent provided by law. Your name or any other identifying information will not be collected as part of this study.

#### **Voluntary participation:**

Your participation in this study is completely voluntary. There is no penalty for not participating. You may also refuse to answer any of the questions we ask you.

#### **Right to withdraw from the study:**

You have the right to withdraw from the study at any time without consequence.

**Whom to contact if you have questions about the study:**

Cierra Carter, M.S.  
Principal Investigator  
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Philip Farber, Ph.D.  
Chair of Doctoral Research Project  
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**Whom to contact about your rights as a research participant in the study:**

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Florida Institute of Technology, IRB  
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**Agreement:**

I have read the procedure described above. I voluntarily agree to participate in the procedure.

- I consent. Begin the study.
- I do not consent. I do not wish to participate.