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Measuring The Effect Of Weighted Devices On Exercise Enjoyment

Nicholas Kruse

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MEASURING THE EFFECT OF WEIGHTED DEVICES ON EXERCISE ENJOYMENT

By

Nicholas Kruse

Bachelor of Science, Dakota State University, 2005

A Thesis

Submitted to the Graduate Faculty

of the

University of North Dakota

in partial fulfillment of the requirements


for the degree of

Master of Science

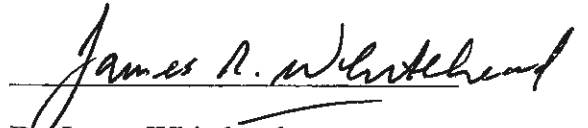
Grand Forks, ND

May 2014

This thesis, submitted by Nicholas Kruse in partial fulfillment of requirements for the Degree of Master of Science from the University of North Dakota has been read by the Faculty Advisory Committee under whom the work has been done and is hereby approved.



Dr. Martin Short, Chairperson

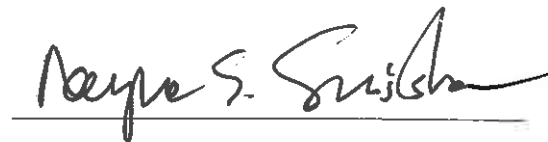


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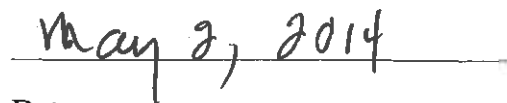
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This thesis is being submitted by the appointed advisory committee as having met all of the requirements of the Graduate School at the University of North Dakota and is hereby approved.



Dr. Wayne Swisher

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Date

PERMISSION

Title Measuring the Effect of Weighted Devices on Exercise Enjoyment
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Degree Master of Science

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ABSTRACT

Physical activity provides an important health benefit for both males and females. Seven out of every ten U.S. deaths are from chronic disease and many of those deaths could have been preventable. With a lack of physical activity and poor diet, chronic illnesses such as obesity, cancer, cardiovascular disease, and type II diabetes were reported, (CDC, 2004). There is a steep decline in exercise from high school to college, which indicates that exercise adherence in college students is an issue. In this study, three conditions were examined with students at the University of North Dakota going through a plyometric protocol that included exercises while wearing a weighted device (vest or shorts) or using regular conventional exercise equipment (dumbbells). Participants completed the Physical Activity Enjoyment Scale (PACES) after each condition. Three, paired-sampled t-tests with the Bonferroni Correction ($.05 / 3 = .017$) to help counteract the issues of having multiple comparisons were conducted. A significant difference was found ($t(31) = -3.27, p = .003$) between weighted shorts and weighted vests. No significant differences were found ($t(31) = -.257, p = .799$) between dumbbells and weighted shorts but the difference between the weighted vest and dumbbell conditions did approach significance ($t(31) = 2.365, p = .024$).

CHAPTER I

INTRODUCTION AND REVIEW OF LITERATURE

Exercise Enjoyment with Devices

Physical activity provides an important health benefit for both males and females. Seven out of every ten U.S. deaths are from chronic disease and many of those deaths could have been preventable. With a lack of physical activity and poor diet, chronic illnesses such as obesity, cancer, cardiovascular disease, and type II diabetes were reported, (CDC, 2004). Only tobacco use caused more preventable deaths.

Within the past decade, progress has been made in research with regards to disease prevention. A focus was made by switching from environmental exposures that people have no real control over, to health behaviors people can control. These behaviors include diet, exercise, and cessation of smoking (Breslow, 1999). Researchers McGinnis, Williams-Russo & Knickman, (2002), stated that the top two causes of premature death are tobacco use along with poor diet and physical inactivity.

Gains in Exercising

Reasons for exercising, especially for strength training, are to gain strength and power which are important factors for success in both highly skilled and recreational athletes. Strength is defined as the maximal force a muscle or muscle group can generate at a specified velocity, while power is defined as the rate of work done over time

(Harmon, 2008). Power is a key ingredient in explosive movements. Plyometrics, or stretch-shortening cycle exercises can increase power for athletes who want to improve their sports (Fatouros et. al., 2000).

Evidence has indicated that regular participation in a resistance training program or training program dealing with plyometric protocol can improve measures of strength and power in adults (Faigenbaum, McFarland, Keiper, Tevlin, Ratamess, Kang & Hoffman, 2007). Also, studies have shown that a change in performance skills resulting from the performance of a combined resistance and plyometric training are greater than either type alone (Faigenbaum, et al., 2007).

Many people don't receive the necessary amount of physical activity daily as well as not adhering to physical activity long term. Lack of motivation can be used broadly to help explain two aspects in exercise. First, people may not be sufficiently interested in exercise, or appreciate what the outcomes can be for them. Second, people may not feel competent with the exercise or activity. With that, certain health barriers or skill sets may limit their involvement in exercise (Teixeira, Carraca, Markland, Silva, & Ryan, 2012).

There is a rapid decline in physical activity among college age individuals, with motivation as the major concern. To be specific, only 38% of college age students participate in regular vigorous activity, and only 20% participate in regular moderate activity. In contrast, 65% of high school students report regular vigorous activity and 26% report regular activity (Kilpatrick, Hebert & Bartholomew, 2005). Kilpatrick et al. used a measurement tool called the Exercise Motivation Inventory-2 (EMI-2) which is comprised of 51 items and 14 factors that represent a wide range of motivations for engaging in physical activity. Some of the factors that were represented were stress

management, revitalization, enjoyment, and some challenges. Several concepts were classified during their study. Physical activity was defined as a broad category of bodily movement that is produced by skeletal muscle, while sport was defined as physical activity governed by formal or informal rules that involve a competition. Exercise was classified as a form of physical activity involving exertion of sufficient intensity, duration, and frequency.

With the lower number of college students compared to high school students exercising on a regular basis, it is important to find out what will get college age students to exercise regularly to stop the decline. Finding an intrinsic motivator may increase the likelihood that college age students continue an exercise routine. The college student needs to feel a source of accomplishment as well as being confident in what he/she is doing. (Kilpatrick, Herbert, & Bartholomew, 2005)

Finding a way to stay motivated is the challenge that stands in the way of many people to reap the benefits of a continuous exercise routine. Benefits of physical activity have been effective in the reduction of anxiety and depression symptoms among other attributes that dealt with other panic disorders (Paluska & Schwenk, 2000). The US Department of Health and Human Services (1996) stated that “one should exercise at least 30 minutes at a moderate intensity for 5 days or more per week to reduce chances of morbidity and premature death” (p. 58).

Motivation in sport refers to the “why” of behavior (McClelland, 1985; Weiner, 1992). The reasons for doing an activity are generally perceived as the person’s motivation toward a given activity. There are different types of reasons athletes take part in sport, such as to seek out new sensations, to attempt to master complex skills, or to

conquer challenging goals, to name a few. Enjoyment has also been recognized as a key factor for motivated and sustained involvement in youth sports (McCarthy, Jones, & Clark-Carter, 2008).

Several behavioral scientists (e.g. Blanchard, 2000; Crombie et al., 2004; Marshall, 2004; Nygun, et al., 2005; Rimmer, et al., 2004) have described the reasons for people not exercising such as an awkward feeling, lack of motivation, perceived lack of fitness, and inability to handle so much change to name a few. With the right equipment and correct environment, people can have a positive experience when working out. Health professionals have battled these issues to ensure people can benefit from their experience while exercising (Nysewander & Ditmyer, 2005.)

The behavioral epidemiology framework can provide a focused approach which may lead to understanding the role of psychology and motivation in healthy behavioral change (Biddle, Multrie, Gorely & Blamery, 2012). With this framework, people can understand the five main phases that it entails (establish links between physical activity and health, measure physical activity, identify factors associated with different levels of physical activity, give the appropriate intervention to promote physical activity, and translate the findings from the research into practice.) Once the framework is in place, phases three through five may be repeated numerous times.

The term “participation motives” has traditionally been used in exercise psychology for the reasons that people give for participating in physical activities. Participation motives are quite similar to the self-determination theory goal contents which people aspire to adopt. The effects of goal contents on well-being are processed either as autonomous or controlling (Markland & Ingledew, 2007.)

Over the last few decades, the study of motivation in humans has moved from a mechanistic perspective (e.g. drive theory) to a complex cognitive approach (e.g. self-efficacy theory, self-determination theory, achievement goal theory). Three areas have been hypothesized to foster a self-motivated process dealing with the self-determination theory which are needs for competence, relatedness, and autonomy (Wang & Biddle, 2007).

“The fullest representations of humanity show people to be curious, vital, and self-motivated. At their best, they are inspired, striving to learn, extend themselves, master new skills, and apply talents responsibly” (Deci & Ryan, pg. 68, 2000). With social contexts catalyzing both within and between persons differences in personal growth as well as motivation that results in people being more self-motivated, energized, and integrated in certain situations, domains, and cultures (Deci & Ryan, 2000).

The Self-Determination Theory (SDT) is an approach to human personality that uses both empirical methods as well as employing a method that highlights the importance of a human’s evolved inner resources for personality development and behavioral self-regulation (Deci & Ryan, 2000). Motivation concerns energy, direction, persistence, and equifinality- all aspects of activation and intention. Motivation has been a central and perennial issue in the field of psychology, for it is at the center of biological, cognitive, and social regulation. More importantly in practical settings, motivation is highly valued because of consequences of production. People can be motivated from the value an activity or there is a strong external coercion (Deci & Ryan, 2000).

SDT can distinguish between two types of motivation; intrinsic (inherent satisfaction) and extrinsic (social well-being). Recently, goal contents (motives) have

been explored in relation to a wide variety of behaviors, exercise included. Specifically, SDT can distinguish intrinsic goals (e.g. affliction, growth, and health) which is thought to be closely related to the fulfillment from extrinsic goals (e.g. power, influence, wealth) which have been thought to be substitute needs; not truly essential to well-being or development (Teixeira et al., 2012).

With an attempt to further clarify which single self-determined type of motivation is more closely related with outcomes dealing with behavior, a meta-analysis of 66 studies was completed by Teixeira and colleagues. Twenty-five studies reported significant associations for both interventions and exercise outcomes. It should be noted that there was not a study that was tested dealing with intrinsic motivation and exercise that was significant in the meta-analysis from Teixeira and colleagues. The authors agreed that identified regulation had a prominent role in exercise adherence when the full range of stages of change is met. The stages are pre-contemplation, contemplation, preparation, action, and maintenance.

Perhaps no single phenomenon reflects the positive potential of human nature as intrinsic motivation, or the inherent tendency to find novelty and challenges and to extend and exercise one's capabilities to explore and learn. However, people are endowed with intrinsic motivation tendencies; it can be readily disrupted by various outside sources. The evidence is clear that the maintenance and enhancement of this property requires supportive conditions to grow (Deci & Ryan, 2000).

Figuring out how and what keeps children motivated and keeps them having enjoyment in exercise is one dilemma that investigators have looked into. Wankel and Kreisel, (1985a) have studied underlying factors dealing with male team sport

participants across specific ages (7-8, 9-10, 11-12, 13-14 years), but placed little emphasis on significant involvement by adults. Using a model developed by Scanlan and Lewthwaite (1986), Wiersma (2001) developed the Sources of Enjoyment in Youth Sport Questionnaire (SEYSQ) to examine the sources of enjoyment among 896 youth athletes aged 12-16 years. In summary, the research has indicated that sport enjoyment can be derived from both extrinsic and intrinsic sources.

Motivation is certainly one topic of the utmost importance with respect to pleasure and satisfaction derived from participation because intrinsically motivating activities are engaged in for these feelings (Chantal, Guay, Dobрева-Marinova, & Vallerand, 1996). To assess satisfaction and motivation, a modified Sport Motivation Scale, Bulgarian Version that was developed by the above mentioned authors was used with 98 elite Bulgarian athletes from a wide range of sports. One example from the scale that was found was that athletes who experience fun and satisfaction in learning new aspects of their sport or athletes who experience pleasure in trying to surpass others while training display intrinsic motivation.

Enjoyment in Exercise

Along with motivation, the enjoyment of exercise must be prevalent in order to accomplish one's goals. Lewis, Marcus, Pate and Dunn (2002), stated that theory-based physical activity interventions successfully influence physical activity behavior. The researchers also stated that these influences are based on theoretical frameworks such as social cognitive theory (SCT) and the trans-theoretical model (TTM). Even though the focus on theoretical constructs mediating physical activity behavior change has increased in recent years, only a few studies have examined whether interventions change

postulated mediators and whether mediators influence physical activity behavior (Pinto, Lynn, Marcus, Depue & Goldstein, 2001).

Goal setting, which in large part helps the individual with intrinsic motivation, is a mental technique that has been used frequently in psychology. Individuals who set specific and goals that are challenging have performed better compared to those who set no goals, limited goals, or were told to do their best (Roberts & Kristiansen, 2012). To enhance performance, along with keeping their intrinsic motivation at a high level, goals are assumed to accomplish such behavior by focusing attention on the task, encouraging persistence, increasing effort, and setting new strategies for performance.

In managing individual motivation, two key aspects have been proven to assist people on a daily basis. Several authors have studied athletes using both short term and long term goals during exercise. Simply put, the use of a long term goal kept the athlete motivated through difficult times when training. The athletes that were studied also said that to win means staying motivated and continuing to train at a high performance level (Roberts & Kristiansen, 2012).

Exercise, from a historical perspective, has been studied for its effects on broad topics such as sleep, stress management, and body esteem (Rejeski, Gauvin, Hobson, & Norris, 1995). McAuley, Motl, Morris, Hu, Doerksen, Elavsky, and Konopack, 2007, investigated physical activity with individuals suffering from Multiple Sclerosis. The group stated that those who did enjoy physical activity more reported greater adherence. Also, they suggest that structuring the environment to facilitate an enjoyable exercise experience may be important.

Although the links between regular exercise and health have been well documented, many people are either sedentary or exercise too infrequently to gather any health benefits. A major practical issue in health promotion concerns how to facilitate adherence to regular exercise. An important distinction concerning motivation in exercise and sport is between intrinsic and extrinsic motives for participation (Ryan, Fredrick, Lepes, Rubio & Sheldon, 1997). Most theorists claim that intrinsically motivated actions are experiences that are of interest or enjoyment along with competence. Other researchers have suggested that it's one's initial motive for exercising, intrinsic motivation that is critical for adherence (Ryan et. al, 1997). Brawley & Vallerand, (1984) viewed intrinsic motivation as a key to exercise adherence, suggesting the spontaneous enjoyment of the activity may contribute to adherence from social interactions. Evidence showed that competence, enjoyment, and body- related motives related to sport and exercise activities as well as adherence and attendance.

Modalities in Exercise

With physical activity in our daily lives, many modalities are used and performed. Many exercisers incorporate some sort of dumbbell activity in their workout routine. Having dumbbells in their workout can assist in gains of strength, power, and flexibility. Adams, Swank, Berning, Sevene-Adams, Barnard, & Shimp-Bowman, (2000), used dumbbells along with other conventional equipment in an 8-week study testing progressive strength training, the dumbbells were used during the “assistance” exercises after finding their 1- repetition maximum lift (1RM). Evidence has shown that the use of dumbbells in exercise protocols has increased the development of muscular strength during an Olympic weight lifting program (Hoffman, Cooper, Wendell & Kang, 2004.) It

is well known that a variety of resistance training programs can stimulate an increase in the 1RM in women, (Kraemer, Mazzetti, Nindi, Gotshalk, Volek, Bush, Marx, Dohi, Gomez, Miles, Fleck, Newton, & Hakkinen, 2000.)

Recent research has focused on the effects of various forms of strength training on running economy (RE) and running performance. One such study examined the effects of a 10- week strength training program on female distance runners. The authors concluded that simultaneous explosive strength and endurance training produced a significant gain in the runners 5- km running performance (Spurrs, Murphy & Watsford, 2003). After taking participants through a 6-week plyometric training program, the RE showed improvements. The main mechanisms responsible for the change appeared to be in the lower body musculotendinous system which led to improved lower body reactive power and a decreased energy cost of running (Spurrs et al. 2003).

There has been some research done regarding the use of different or less common exercise devices and their effects on enjoyment, motivation, and adherence. One common practice involving devices recently is incorporating the use of a pedometer during a “normal” day. Gao, (2008), stated that school physical education programs can reach children and adolescents and play a crucial role in increasing the amount of physical activity and reducing sedentary behaviors in these age groups. Gao also mentioned that students’ positive motivation toward physical education has been identified as an important contributor to active engagement in classes. It was found that participants displayed relatively high motivation in physical education, as all mean scores of perceived competence and enjoyment were above the midpoint of the measures.

Higher intensity modalities such as plyometrics (timed, explosive, jumping movements) are used to strengthen the muscles by creating a stretch reflex within the targeted muscle group by the hip, knee, and ankle joints. The word “plyometric” is a combination of Greek words that literally means increase measurement (plio meaning “more” and metric meaning “measure”). Plyometric exercises can bring about a potentiation or change in the force-velocity characteristics of the muscle’s contractile components caused by the stretch of the concentric muscle action by the use of the stretch reflex. The stretch reflex is the body’s involuntary response to an external stimulus affecting muscle spindle activity. (Potach & Donald, 2008)

There are three phases to a plyometric exercise (Baechle & Earle, 2000). The first phase is the eccentric phase, known as loading or exciting of the muscle spindles with elastic energy. The second phase, the amortization phase, is the time between the concentric and eccentric stage of the exercise. Phase three, the concentric phase, is where stored energy is used to create the force.

When performing lower body plyometrics, it is possible to wear weighted devices during workouts. Many different types of devices have been used including chutes, sleds, weighted vests, and weighted shorts. From a physiological perspective, the weighted devices allow the body to recruit more muscle fibers to enhance athletic performance and may require more neural activation (Faigenbaum et al, 2006).

Several coaches and researchers have studied lower body plyometrics to determine if the workouts can improve vertical jump performance. Fatouros et al., (2000) randomly assigned 41 men into four groups of training to test different protocols dealing with lower body power performance and leg strength and were able to measure

mechanical power, flight time, and maximal leg strength before and after a 12 week training period. It was concluded that the group that performed both the weight training protocol along with a plyometric protocol performed significantly better in lower body power and agility tests than the other groups that performed weight training, plyometric training, or the control group.

Burkett, Philips, & Ziuratis (2005) stated that the vertical jump has high importance on draft status in the National Football League and that any improvements that can be made may have important consequences for the athlete's future. The investigators had all speed position players (receivers, running backs, defensive backs) complete 4 different protocols: specific warm-up, specific weight jump protocol, a stretching protocol, and conducting no warm-up. There were several differences found between the protocols. Vertical jump performance was the highest with a weighted warm-up and the lowest with no stretch.

High impact activities like plyometric training, and low impact activities including leisurely walking and aqua aerobics have been beneficial for all types of people. Most regular exercisers use conventional equipment including cardiorespiratory equipment and resistance training machines. A less frequently used tool available for health clubs and fitness professionals are weighted vests and shorts. An advantage of weighted vests is that all types of people, from novice to expert, can have beneficial gains from their use (USDHHS, 1996).

Weighted vests have been shown to increase aerobic capacity as well as functional performance. Other potential benefits of weighted devices are the balance, posture and functional movement advantages of not having to carry dumbbells in hand

while performing various exercises (Nysewander & Ditmyer, 2005). Bars and dumbbells must be balanced while holding them and the onset of fatigue may occur sooner.

Gravitational forces on an object act downward. Exercise technique can affect resistive torque patterns and can shift stress among muscle groups during exercise (Harman, 2008). A weighted device however, gives the person hands free mobility which may reduce the rate of fatigue a person undergoes.

To date, there has been limited research on the enjoyment of wearing weighted devices during exercise to increase adherence. Increasing the enjoyment of the exercise may be obtainable by changing the method the individual uses such as the addition of weighted devices when exercising. In this study, enjoyment will be measured in those who wear these devices when exercising compared to more conventional means such as dumbbells.

Hypothesis

It is hypothesized that using weighted devices (vests and shorts) will result in a more enjoyable exercise sessions than using dumbbells for added resistance. There is no reason to believe that there will be a difference between weighted shorts and weighted vests.

CHAPTER II

METHOD

Participants

Both male ($n=17$) and female ($n=15$) undergraduate students, between the ages of 18-24 from the University of North Dakota. Recruitment was conducted by word of mouth from the summer semester to the end of the fall semester.

Procedures

All participants were asked to sign an informed consent form. All participants were grouped together and followed the same protocol (in randomized order).

The independent variable studied was the exercise protocol with three separate conditions, while the dependent variable was exercise enjoyment. The participants were following a lower body plyometric protocol with the weighted devices (vests and shorts), along with doing the protocol using dumbbells at the same weight as the devices to keep resistance the same. The same questionnaire was given out to each participant before starting the study and after the study was completed. As mentioned, a lower body protocol was conducted during a one week time frame. Each participant met 3 times for sessions that lasted approximately 30 to 45 minutes. During this time, each participant warmed up and then followed a lower body plyometric protocol. The protocol was completed either with the weighted shorts, the weighted vests, or normal workout attire

with dumbbells. The groups were randomized to limit any temporal bias. The equipment used in the study were ten pound, self-adjusting, weighted speed vests and speed pants from Iron Wear Fitness, Pittsburgh, PA, were worn in this study, along with normal workout attire. The equipment was comprised of self-adjusting nylon laminate pants and vests with Flex-Metal made of steel and polymers to create the ability to flex during movement. Illustrations of the devices can be found in Figure 1 and Figure 2. The dumbbells that were used are PB Extreme 5 pound dumbbells from the University of North Dakota Strength and Conditioning weight room. An illustration of the dumbbells can be found in Figure 3.

Figure 1. Weighted Shorts



Figure 2. Weighted Vest

Long Speed Vest™
adjustable from 1 to 17lbs



Figure 3. PB Dumbbells



Measurement of Enjoyment

The Physical Activity Enjoyment Scale (PACES) created by Kendzierski and DeCarlo, (1991) was used to measure participants exercise enjoyment. The PACES Scale was developed to measure physical activity enjoyment using college-aged students. The scale is a 5-point Likert-type scale that ranges from 1 (“Disagree a lot”) to 5 (“Agree a lot”). The original scale included 18 bipolar statements. Motl, Dishman, Saunders, Dowda, Felton, & Pate, (2001) modified the scale by removing two of the statements, items 5 and 11, and the wording of the statements were rewritten to ensure comprehension. For this study, the scale was modified to the past tense to question post-workout understanding of enjoyment by Knight and Whitehead (2012) which had a satisfactory internal reliability that was reported (scale alpha .84) and is included in Appendix A.

Training Procedures

The lower-body plyometric training protocol workout was derived from a previous study conducted by Myer, Ford, Palumbo, & Hewett, (2005). Exercises dealing with the BOSU ball were unnecessary for this study and timed events (e.g. 15 seconds) of the protocol were changed to a set number of repetitions (15 reps) to ensure all participants did the same number of jumps. The protocol was designed to ensure that all individuals could participate; no matter how skilled or athletic they were when exercising. The goals and focus were to improve from the previous day and were mentioned by the investigator during each session. Feedback on technique was given to each participant to ensure proper biomechanics during training. Training sessions included both dumbbell exercises as well as exercises with weighted devices to compare

enjoyment of use and were conducted three days a week and lasted for approximately 30 to 45 minutes with an active warm-up. The active warm-up consisted of jogging from end to end of a basketball court, followed by walking high knee lifts to half court and back, followed by walking butt-kicks to half court and back, and ending with jogging from end to end on a basketball court. Before any exercises began, proper landing and athletic position was demonstrated to and practiced by all participants. The training protocol can be found in Appendix B.

CHAPTER III

RESULTS

The main purpose of this study was to compare a lower body plyometric protocol with three different conditions (either with a weighted devices or with a conventional piece of equipment) to understand which was the most enjoyable by measuring the outcome with the PACES.

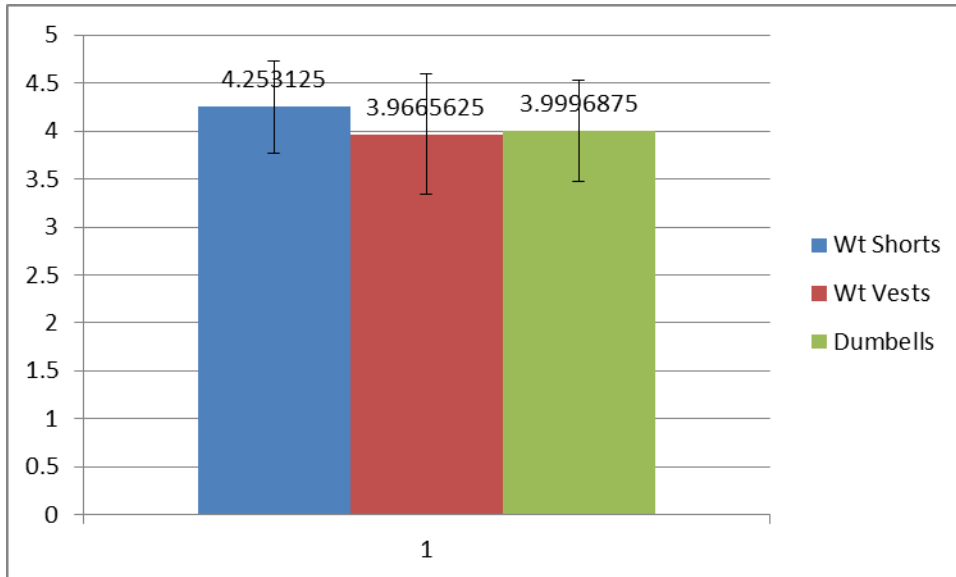
Descriptive Statistics

Statistical analysis was conducted by using IBM SPSS Statistics Version 21. Three, paired-sampled *t*-tests ($p \leq .017$) with the Bonferroni Correction ($.05 / 3 = .017$) to help counteract the issues of having multiple comparisons were conducted. A significant difference was found ($t(31) = -3.27, p = .003$) between weighted shorts and weighted vests. No significant differences were found ($t(31) = -.257, p = .799$) when comparing dumbbells to weighted shorts, but the difference between weighted vests and dumbbells did approach significance ($t(31) = 2.365, p = .024$).

Table 1. Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	weightedshorts - weightedvests	-0.28711	0.49668	0.0878	-0.46618	-0.10804	-3.27	31	0.003
Pair 2	weightedvests - dumbbells	0.25391	0.6074	0.10737	0.03491	0.4729	2.365	31	0.024
Pair 3	dumbbells - weightedshorts	0.0332	0.73111	0.12924	-0.23039	0.2968	0.257	31	0.799

Figure 4. Bar Graph of Enjoyment Ratings with Standard Deviations



CHAPTER IV

DISCUSSION

The main purpose of this study was to compare a lower body plyometric protocol with three different conditions (either with weighted devices or dumbbells) to understand which was the most enjoyable by measuring the outcome with the PACES. The mean score for all three devices was approximately 4 (3.96-4.25) which indicates that all three conditions were enjoyed by the participants. Even though the mean scores were fairly close, numerous participants stated that they enjoyed using the vest more than the other two devices. The comparison between the weighted vest and the weighted shorts was the only condition that showed significance with $p=.003$. The other two comparisons, weighted shorts and dumbbells were not significant, but the weighted vest and dumbbells approached significance.

Weighted Device Comparison

Within the study, we compared the use of different weighted devices. Biomechanically, each device may have changed the center of gravity (COG) by adding weight to a specific region of the body. When wearing the weighted vest, the COG shifted higher towards the chest and shoulders. With a lower COG, stability increases and mobility decreases (Hamilton & Luttengs, 2002). There is an indirect relationship

between mobility and stability. When greater stability is present, it is more difficult to start the body moving (Hamilton, Weimar & Luttgens, 2012). This stability/mobility relationship may explain why participants preferred the weighted vest over the weighted shorts (more mobility during the plyometric protocol). Another critical factor that arises is the relationship between COG and momentum. If motion vectors and COG are not in the same direction as momentum of the body, regaining static balance may become difficult to achieve (Hamilton et. al., 2012). Holding the dumbbells, the COG may have had some change during the exercises. Unlike a rigid barbell that has more of a fixed COG, dumbbells are more freely movable and could cause greater fluctuations in COG (Rutherford, 2006).

Exercise Specificity

It's possible that restrictions to the hip joint during the use of the weighted shorts created an unnatural feel during the intervention. With the hip joint being affected, participants may have found it less enjoyable when compared to the weighted vest or the dumbbells. The weighted vest condition appeared to be the most enjoyed of all three conditions and the dumbbells may have made the movements more difficult, no matter the level of the participant, by shifting the COG depending on how they were carried (Rutherford, 2006). When arms are raised or if weight is being carried above waist level, the COG shifts higher making equilibrium more difficult to maintain (Hamilton & Luttgens, 2002).

Limitations

There were some limitations to the study. The weighted devices may have been unfamiliar to the participants not in athletics, particularly the correct position of the shorts around the waist. The length of regular shorts worn underneath the weighted shorts may have had an impact on comfort during the protocol. Another limitation may have been the level of athletic ability of the participants. Some of the participants were more highly skilled that went through the study had been on sports teams at UND in the past and have been through more advanced weightlifting routines, while others that took part were novices or less experienced college students, and had not played sports competitively since high school.

Future Research and Directions

More research should be done in the area of weighted exercise devices to ensure the correct device is used with different exercise protocols. It may also be of interest to see if athletic experience has any effect on exercise enjoyment with various weighted devices or if increased enjoyment using a particular weighted device has an effect on performance. A short questionnaire that gathers personal preference about which weighted device was the most enjoyed could also be used to gain qualitative data in future research.

Conclusion

In conclusion, it appeared that the weighted vest condition was the most enjoyable during the exercise protocol when compared to the weighted short condition or the dumbbell condition. Even though each participant varied in their enjoyment of the three interventions, each type of device may be used effectively as a warm-up before conducting an exercise routine. Thompsen, Kackley, Palumbo & Faigenbaum, (2007), found the performance of both vertical jump and long jump were significantly greater following a dynamic warm-up wearing a weighted vest compared to without wearing a weighted vest. They also stated that athletes holding dumbbells equivalent to 10% of body mass enhanced the outcome of their vertical jump.

Appendix A

Physical Activity Enjoyment Scale

For each statement below, select the response which best represents how much you “disagree” or “agree” with the statement. Mark your response by checking the appropriate box.

With regard to the exercise that I just completed...	Disagreed a lot	Disagree a little	Neither agree nor disagree	Agree a little	Agree a lot
1 I enjoyed it					
2 I felt bored					
3 I disliked it					
4 I found it fun					
5 It wasn't fun at all					
6 It gave me energy					
7 It gave me energy					
8 It was very pleasant					
9 My body felt good					
10 I got something out of it					
11 It was very exciting					
12 It frustrated me					
13 It was not at all interesting					
14 It at gave me a strong feeling of success					
15 It felt good					
16 I felt as though I would rather be doing something else					

Appendix B

Exercise	Sets	Time or Reps
Wall jumps (ankle bounces)	1	10 reps
Barrier jumps (front to back) speed	1	10 reps
Barrier jumps (side to side) speed	1	10 reps
180 degree jumps (speed)	1	10 reps
Lunges (forward)	1	10 reps

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