

A Dissertation

Entitled

The Effect of A 5-Day Rapid Loading Phase of
Creatine Monohydrate And Its Effect On Output When
Performing A Strength And Power Test

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INTRODUCTION – Chapter 1

The goal of both athletes and recreational non-athletes in sports performance and exercise is to improve their health and optimize their physical performance. While a variety of activities and factors contribute to this end, many people choose to enhance performance (i.e., increased muscular power, strength, and force) through exercise and nutrition strategies, (Kerksick et al., 2018). People are always looking for ways to improve their efficiency while exercising, many people use a variety of supplements to enhance their abilities. Athletes and non-athletes tend to use supplements to increase and accelerate their growth in a shorter timeframe. In order to achieve "faster results," people tend to take supplements that will aid them in achieving this goal. The world of natural and sustainable growth tends to lack views when comparing to the world of supplements, growth and metabolic enhancers. That doesn't take away from the benefits of many supplements there are on the market today. Many supplementations have great benefits and reward users with substantial results.

Creatine is one of these supplements that people use to increase their strength and improve their performance. The use of Creatine was first discovered in 1832 and can be traced back to the mid-1800s, (Trexler & Smith-Ryan, 2015). It is now used widely by recreational, collegiate, and professional athletes of all levels, (Greydanus & Patel, 2010). During the 1992 Olympic Games in Barcelona, creatine supplementation gained mainstream popularity, (Close et al., 2016). Since then, creatine has only been growing more and more popular with time.

The use of creatine has been widely researched, over 500 peer-reviewed publications have been published on creatine supplementation according to PubMed (a database of biomedical and life sciences journals from the U.S. National Institutes of Health's National Library of Medicine). A new position stand on the safety and efficacy of creatine supplementation in exercise, sport, and medicine was published by the International Society of Sports Nutrition (ISSN) in 2017 based on its enormous popularity, (Candow et al., 2021) (Kreider et al., 2017).

In terms of ergogenic aids, creatine is one of the most researched and most effective supplements for increasing sports performance and enhancing abilities. The complex mechanism by which creatine increases muscle mass and physical performance includes

enhancing anaerobic energy capacity, decreasing protein breakdown, and increasing anaerobic energy, (Kreider et al., 2017).

The natural source of creatine which we get from our food sources comes from our consumption of meat. As creatine is predominantly found in meats, vegetarians have lower resting creatine concentrations because their consumption of meat is non-existent, (Burke et al., 2008), (Cooper et al., 2012). The importance of creatine in our bodies found in its natural amounts is helping the body to maintain muscle mass by reducing protein breakdown, the increase in anaerobic energy helps us to use fat stores to release energy while doing moderate exercise. A greater aerobic capacity increases oxygenated blood flow to muscle tissue, which is necessary for mitochondrial density to increase. It is mitochondria that produce adenosine triphosphate (ATP) for the muscle cell to contract, which is then used for energy, (Hargreaves & Spriet, 2020). Muscle cells transport creatine into the cells via a specific transporter, increasing intracellular creatine and phosphocreatine levels. ATP concentration is protected by phosphocreatine, which functions as an energy buffer. Exercise performance and recovery are therefore improved when muscle nucleotides are maintained, (Brault et al., 2007).

Looking at the benefits that supplementing creatine has on recovery during exercise, in addition to improving performance during exercise. Research by (Wax et al., 2021), indicates that creatine augments performance across multiple areas of performance and subsequently demonstrates a role in enhancing recovery. Physiological, subjective, and performance-based parameters are typically included in the definition of recovery. A positive effect of creatine can be seen in recovery, in terms of physical performance after intense exercise, and it has also been shown to enhance recovery during intermittent exercises, allowing maximal performance to be sustained across multiple exercise sessions. Additionally, creatine supplementation may reduce inflammatory responses to exercise, attenuating soreness and inflammation in the hours following a bout of exercise-induced muscle damage. As a last resort, creatine may be effective as a therapeutic intervention following an injury or when limbs are immobilized for an extended time.

Creatine has its many benefits and enhancements when supplementing the agent, but what about how a short-term creatine loading phase will then affect a person's output when they perform specific exercises related to specific areas of performance, like a 1 rep max bench press to measure strength or a peak power chest press to measure power. The evidence based around specific workouts is very supportive and indicates that short loading phases (rapid

loading) of 5 days has an impact on the body creatine stores. (Law et al., 2009), states that levels of improvement on strength and power are indicated after a short loading phase. The reason for this research is to find out how short-term loading of creatine affects a person's output when performing a 1RM in bench press and a peak power chest press, and to record their output pre ingestion and post ingestion of creatine monohydrate.

This purpose of this research is to look at how a 5-day rapid loading phase of Creatine Monohydrate will affect the performance output when measuring for strength by performing a 1 Rep Max on a bench press and measure power through a Keiser pneumatic power machine. These tests will give as a look at how creatine affects the performance of an individual during supplementation.

Literature Review – Chapter 2

Why do people use creatine?

There is a great deal of research supporting creatine's effectiveness as a dietary supplement. A large amount of literature demonstrates that creatine can enhance performance after short-term (5–7 days) and long-term supplementation periods. A strong safety profile and minimal risk for adverse events are also strong arguments in favour of creatine's use as a clinical health and safety supplement. As a result of recent research, creatine has also been shown to provide numerous health-related benefits in certain clinical populations in addition to its cognitive capabilities, (Jagim et al., 2018). In general, ergogenic aids are methods, apparatus, nutritional agents, pharmacological agents, or psychological techniques that can improve exercise capacity or enhance training adaptations, (Kerksick et al., 2018). In terms of dietary supplements, creatine is one of the most researched and effective nutritional ergogenic aids available to athletes and non-athletes. Human diets that supplement creatine can increase intramuscular creatine stores, improve exercise capacity, and improve training adaptations, (Kreider et al., 2017). Phosphocreatine makes up approximately two-thirds of intramuscular creatine, and free creatine makes up the remaining third. There is an upper limit (after supplementation) of up to 160 mM/kg dry muscle mass for a 70-kg individual who averages 120 mM/kg total creatine (PCr + Cr). To maintain normal levels of phosphocreatine, 1–3% of the exogenous creatine must be converted to endogenous creatine, resulting in a daily total (exogenous + endogenous) of 1–3 g. The human diet generally supplies up to half of this amount with meat and fish providing 1 to 2 grams of creatine per pound, and uncooked beef supplying 6-8 grams of creatine per pound. Endogenous synthesis occurs in the kidneys and liver to provide the remaining portion of the total rate of appearance, (Harris et al., 1992). ATP is resynthesized by both free creatine and phosphocreatine found in skeletal muscle, which serves as a substrate for phosphorylation and substrate-level phosphorylation, (Jäger et al., 2011). During high-intensity exercise, depletion of these high-energy phosphates is accepted as a major cause of fatigue due to their role in several metabolic processes within the body, (Gastin, 2001), (Lamb & Westerblad, 2008). It can be argued that the desire to use creatine as a booster in health benefits and performance benefits bows down to all the research stating its usefulness in aiding improvement in daily cognitive and performance boosts. These benefits promote the popularity of using creatine in everyday life by many people from athletes to non-athletes.

How does creatine affect muscle growth?

Strength training and protein supplementation are common methods of growing muscles. Strength and size increases in skeletal muscle are enhanced by dietary protein intake, which stimulates muscle protein synthesis after exercise, (Hartono et al., 2022). Muscles, brains, and other tissues with high energy demands and fluxes utilize creatine, an ergogenic compound, (Brosnan & Brosnan, 2007). As an endogenous substance, it is made by the kidneys and liver from the amino acids, arginine, glycine, and methionine, (Wyss & Kaddurah-Daouk, 2000). Supplementing skeletal muscle tissue with creatine monohydrate can increase the ratio of phosphocreatine to creatine, which increases the capacity for rapid adenosine triphosphate (ATP) synthesis, (Bodin et al., 1994), (Van LOON et al., 2003). Muscle tissue retains water following creatine supplementation, which may contribute to the increase in lean mass, (Hultman et al., 1996), (Ribeiro et al., 2020). Muscle cells are said to swell as a result of higher osmotic pressure following increases in creatine content, (Kreider et al., 2017). The growth of muscles uses creatine from creatine stores inside the body already, this is a factor which can aid in the growth of muscle tissue. The supplementation of creatine boosts the ability of this process to increase growth of muscle tissue. Ingestion of creatine may benefit muscle growth, aiding in faster enhancement capabilities, according to research.

How does creatine increase strength?

If creatine increases muscle mass how does this play into strength, and what does increased intake of creatine do to increase strength. There were two studies that recruited healthy, untrained young subjects. In an experiment by (Del Favero et al., 2011), creatine supplementation was given for 10 days at a high dose (20 g per day). Even without training, muscle power output and muscle strength increased in the creatine group compared to the placebo control group after squat exercises and bench presses. In the study by (Kaviani et al., 2019), a maintenance dose of creatine supplementation (0.07 g/kg per day for 56 days) was combined with whole-body resistance training. When compared to the placebo control group, the creatine group showed an increase in muscle strength within two weeks after bench pressing, leg pressing, and shoulder pressing. By six weeks after performing tricep extensions, muscle strength had increased. The creatine group showed an increase in creatine kinase compared to the placebo group. The results of these two studies demonstrate that loading creatine increases strength output when compared to taking a placebo. This indicates that creatine is being utilised by the body and increasing performance gains. A study by

(Chen et al., 2022), concluded that with adequate training in a variety of dosage strategies and athletic activities, creatine can increase muscle strength, muscle mass, and athletic performance in healthy young adults.

In women as well as men, creatine supplementation has been reported to be beneficial. However, most studies have focused on men and some studies suggest women may not see the same gains in strength and/or muscle mass as men, (Benton & Donohoe, 2010), (Johannsmeyer et al., 2016), (Ramírez-Campillo et al., 2016). A position statement of the International Society of Sports Nutrition (ISSN) regarding creatine supplementation previously concluded that creatine monohydrate is the most effective ergogenic nutritional supplement currently available to athletes for increasing exercise capacity and lean body mass during training, (Kreider et al., 2017). The current research with their focus on the effect creatine has on the body and strength indicate the multiple benefits from supplementing creatine and the usefulness creatine has in sports and exercise.

There is a compelling argument that increases in intramuscular phosphocreatine concentrations are responsible for these ergogenic effects resulting from creatine supplementation, (Kraemer & Volek, 1999), (Kreider et al., 2017). It has been shown that creatine supplementation can increase resistance training volume and work output as a result of its ability to enhance strength and power output and expedite recovery after intense intermittent exercise, (Mills et al., 2020). Which may then translate into greater strength gains as a result followed by other performance gains too.

How does creatine increase power?

Many Research articles indicate the effect creatine loading has on power output. A study done by, (Nevill et al., 2022) established that creatine supplementation led to an increase in body mass of 0.99 ± 0.83 kg ($p = 0.007$), an unchanged peak power output and peak running speed in both groups, while a significant increase in power output and running speed during the last 5 seconds of the sprints was observed at 4.5% ($p = 0.005$) and 4.2% to 7.0%. As fatigue comes into play during the last moments of the exercise, creatine boosts the participants' power output by reducing lactate levels in the body this is due to the fact creatine turns ADP into ATP by donating its phosphate group, (Walsh et al., 2001). (IZQUIERDO et al., 2002), found that the number of repetitions performed to fatigue increased, and total average power output values increased in the R(max) set of maximal strength, muscle power

production during repetitive high-power-output exercise bouts (MRPB) during bench press (21% and 17%, respectively) and half-squat (33% and 20%, respectively), the 1RM(HS) (11%), as well as the CMJ values after the MRPB half-squat increased by (5%). Research highly indicates increases in power output by supplementing creatine there have been increases in power by 4.5% in sprints, while there were 21% - 17% recorded for bench press. The increases in power after supplementation of creatine indicate the growth and improvements that the ergogenic aid has on enhancement of performance.

Research shows that with creatine supplementation combined with a resistance training program, (Law et al., 2009) reported significant gains in back squat strength and average anaerobic power during a Wingate test. Creatine loading for only two days did not elicit similar strength and power-related benefits, suggesting that perhaps creatine loading for more than two days is required to elicit a significant strength and power benefit. The effects of resistance training on young adult males who were naive to it have also been reported, in the short term a 10-day creatine supplementation enhanced strength and power output in bench press and squat exercises, (Del Favero et al., 2011). Despite not participating in resistance training during the supplementation period, subjects still exhibited ergogenic benefits. Studies indicate that the loading of creatine enhanced the participants power output for bench press and squat exercises despite having no previous experience in performing these exercises. The current research relating to creatine does indeed indicate that the loading of creatine shows great improvements in performance of strength and other performance areas, even when participants were not trained in resistance training still displayed improvements in their performance.

How do different variations in loading creatine affect performance?

Creatine loading comes in many variations different researchers have found different methods of loading creatine. These can range from rapid loading then reducing load after creatine stores have been filled, to slow loading which can be done over a longer period. (Bemben & Lamont, 2005), stated that a variety of Creatine loading programs have been studied; the most common involves a loading phase of 20g per day for 5-7 days followed by 3-5g per day for varied lengths of time (1 week to 6 months). (Law et al., 2009) concluded that over the 5-day supplementation period, the creatine supplementation group consumed 20 g of creatine per day (4 doses of 5 g per day), while the placebo group received a placebo similar in appearance and taste. In order to determine the effect of 2 and 5 days of creatine

loading, anaerobic power and strength performance measures, as well as blood and urine analysis, were performed before the supplementation began and on the third and sixth days. Anaerobic power and average creatine loading were significantly improved after a 5-day creatine loading regime combined with resistance training. It was found that even increases in creatine uptake in the body after 2 days of supplementation did not produce similar performance gains as those obtained after 5 days of loading. The standard 5-day loading regime should hence be prescribed to individuals supplementing with creatine for enhanced strength and power. In order to increase strength and power, creatine supplementation should be prescribed according to the 5-day loading regimen. A study conducted by, (Hultman et al., 1996) found that besides supplementing without loading phases, a "cycling" strategy is also suggested. It has been reported that protocols without loading periods are sufficient to increase muscle creatine (3 grams per day for 28 days), and muscular size and strength (6 grams per day for 12 weeks), (WILLOUGHBY & ROSENE, 2001), (WILLOUGHBY & ROSENE, 2001). Majority of studies undertaken on creatine effects have used a 5–7-day loading phase, the results have shown that the use of rapid loading has proven results and participants start to show results even after day 5 of loading. The issues pertaining around creatine studies is a lack of information on slow loading protocols, this area hasn't been studied extensively and therefore isn't showing the effects of long-term loading of creatine. The need of understanding the alternatives is essential to know how it will affect the long-term use of creatine, the lack in research is mainly down to the length of studies having people take a supplement for such a long period of time will prove difficult in keeping the studies accurate. Having people take the supplement in a controlled environment will require an extensive study which will require funding to facilitate. When conducting research without having full control of every scenario and control of each deployment of rules will allow for results to be obscure. Allowing People to supplement in their own time over a lengthy study will cause some missteps as people tend to forget, and this will cause missed days and even weeks of supplementing, therefore the accuracy of research will be affected.

How does creatine loading affect performance in 1rm?

It has become widely recognized that complex training is an effective way to develop strength and explosive power at the same time, (Freitas et al., 2017). This is the reason many of the research papers on creatine adopt a training regime to go along with the supplementation because it improves the outcome. Creatine loading as previously mentioned

ties into how the body takes up creatine and stores it for use when performing activities and exercises. Now the use of creatine complements the level of training, the harder the training the more useful creatine is to the body, this is because creatine allows for increased volumes of work and increased work output while performing resistance training, (Wax et al., 2021). The level of increase in power typically bows down to how you utilise the creatine stores in the body. A study by, (Kreider, 2003) found that the level of power has shown to increase by 5-15%. Many studies indicate the level of strength and power that comes from creatine typically reside in the 5-15% mark. A study by, (Mills et al., 2020) found that males supplementing creatine experienced a significant increase over time for chest press (Creatine: pre 166.53 ± 22.82 kg, post 187.59 ± 18.64 kg; $d = 0.47$, observed power = 0.55) with no change for males on placebo (pre 181.05 ± 38.71 kg, post 180.30 ± 43.07 kg). Looking at studies which support how creatine increases strength and power, there are studies which indicate otherwise. A study by, (Housh et al., 2012) indicates that young adult males without concurrent training did not differ in strength for 1 RM bench press or 1 RM leg extension exercises after 7 days of creatine or placebo supplementation. This study again indicates that participants with no concurrent training didn't gain any affect from using creatine, comparing this to other studies, (Bemben & Lamont, 2005) found that sport performance is most enhanced when Cr is consumed during repeated, short bouts of high-intensity exercise. Supplementing Cr appears to be most beneficial to athletes who perform sports like their type of activity. Soccer, squash, lacrosse, and football are the most common types of sports that use Cr.

Due to its popularity as an ergogenic aid, creatine will be a widely researched topic. Due to its benefits and ability to provide such levels of performance aid in such a short period of time, it's no wonder creatine is the most popular supplement on the market. It is difficult to measure the effects of long-term use in this field and the research does not indicate what the problems are. Several studies indicate that creatine has great benefits and others indicate that it has very limited benefits when looking at how it affects certain exercises.

Based on the studies hypothesis from the literature review, it can be concluded that the research has many similarities when looking at creatine through short term loading. Studies indicate creatine can produce results even when choosing a short-term loading phase for 5-7 days.

The primary focus of this study is to look at how creatine influences power while measuring using a peak power chest press and strength through a 1 rep max (RM) bench press.

Additionally looking at how a 5-day loading phase will affect the performance of power and strength during these tests. The research will try to develop practical analysis on the effects of creatine on both power and strength during a rapid loading phase. Research will also assess the effectiveness of creatine on the development of strength and power in the short term. To explore the effectiveness of short-term gain from creatine and to compare the already researched theory of creatine against the research conducted in this study.

Method – Chapter 3

Section 1 – Introduction

This chapter will be broken down into 4 sections first the introduction, this section will introduce the chapter leading into the methodology. Then we will look at the research design and what methods are going to be used to collect the data and run the experiment and the justification of why each method was chosen to collect the data. Section 3 will investigate the limitations of the research and how certain adjustments and compromises had to be made because of the scope of the experiment and the limited resources available. Section 4 will conclude the chapter and summarize what has been presented.

The aim of the research is to find out how a short-term rapid loading phase of creatine will affect the output of both strength and power, this study will look at the effect of a 5-day loading phase and how it will change the results while comparing the pre ingestion and post ingestion results while performing 1 RM bench press and peak power chest press. The initial phase of this experiment will solely ask participants who are able to take part and assist in finding results for this experiment.

Section 2 – The Research Design (Quantitative Research)

This research will focus mainly on data collection and forming analysis with current research on creatine. To begin with we will look at the participants and how they were chosen.

Subjects and Subject Demographics:

The participants chosen for this study were not chosen at random, chosen participants were teachers and friends and willing to participate in the research. The chosen participants were approved by the University of Wales Trinity St David. They were well informed of the possible dangers and risks of participating in this research before providing their written consent to partake in the experiment.

This study was limited to 6 male participants who were all healthy and between the ages of 18 – 57 years old. Participants were asked before accepting to take part if they had any

ongoing health related issues, any participant with health issues were deemed not able to partake in the experiment. The health-related issues which were asked to the participants are:

- Heart troubles
- Strokes
- Chest or heart pain
- Breathing issues
- Dizzy spells
- Blood pressure (High/Low)
- Asthma
- Diabetes
- Epilepsy
- Arthritis
- Medication
- Medical conditions

This was all determined by participants filling in a health questionnaire.

During the initial process of data collection physiological measurements were recorded before and after the completion of the exercises. The data collected was:

- Age (years)
- Height (cm)
- Weight (kg)
- BMI
- Body fat (%)
- Muscle (%)

The body composition was recorded using a highly technical body composition machine at the university.

Experimental Design:

The study utilised one group of 6 people informed about all the specifics of the experiment, the participants were informed of all the parameters and the reasoning behind each set of data

collection. Participants were instructed to attend the laboratory on 2 separate occasions over the course of 1 week.

The participants were made to perform 2 exercises (1RM Bench Press and Peak Power Chest Press) before starting the creatine loading phase. The 1RM bench press was performed on a powerlifting rack in the University's sports lab and the peak power chest press was also conducted in the same facilities using the Universities Keiser Pneumatic Resistance Training Machine.

During the 1RM Bench Press participants were asked to undergo a progressive warm up routine, this was done to get the participants blood flowing and ready to undergo the testing phase for this experiment. The warmup routine consisted of a (Light jog, push ups). Research by (Park et al., 2018), indicates that in addition to improving exercise performance and reducing injury risk, warm-ups increase muscle temperature and blood flow. Exercise performance and flexibility are enhanced and maintained by warming up, as well as injury prevention through the increased range of motion of the joints.

After that, participants performed 1RM Bench Press as the first exercise. The movement was performed at a set weight after starting at a weight that was considered easy for the participant. They decided among themselves which order each person would follow. Every rep resulted in a 5kg increase in weight until each person felt they were near the end. To achieve a more accurate recording of 1RM, we reduced the weight by 2.5 kg for each participant once they reached their 1RM. Bench press is an effective workout which can measure strength, in numerous professional sports, including football and basketball, bench presses have been used to test and train upper body strength, (Ebben et al., 2004). The 1RM was performed by participants preloading and post loading of creatine, the exact same procedure was followed when obtaining results.

Moving on from the first exercise participants were asked to perform the peak power chest press. This machine allows a measure of how fast work is done ($\text{Power} = \text{Work} \div \text{Time}$). Fitness terms define this as the speed at which weight (resistance) is moved. $\text{Power} = \text{Force (strength)} \times \text{Velocity (speed)}$. Functional training must be performed at speed in order to be considered effective. In a Keiser machine, power is measured by pushing with both arms as fast as possible in imitation of a chest press. The Keiser machine procedure was like the 1RM Bench Press. Participants performed the power chest press until they reached their maximum

power output. The Keiser peak power chest press was performed by participants preloading and post loading of creatine, the exact same procedure was followed when obtaining results.

Loading Phase Off Creatine:

This research will involve participants taking part in a 5-day rapid loading phase (rapid loading) in order to load creatine. Twenty small bags containing five grams of creatine were given to participants during this phase. It was recommended that participants consume four bags each day at four different times, preferably after a meal. Each participant was instructed to measure out enough time per dose and consume it throughout the day when it was convenient for them. Choosing a duration of 5 days was solely based on research that has already been conducted; most research indicates that results are immediately apparent after 5 days, (Bemben & Lamont, 2005), (Hultman et al., 1996), (Law et al., 2009). As part of the loading phase, participants were required to keep track of their dosages. Participants were asked to carry out daily activities as normal and keep up with their level of exercise as they would normally.

Following the loading phase, participants will repeat the exercises using the same training plan as before. All data collection for the study will be recorded at the University of Wales Trinity St David (UWTSD) sports lab.

Each participant's last rep was recorded using the weight in (kg) for the 1RM bench press, while the peak power was recorded on the computer while each rep was being performed. Computer displayed final power figures and they were noted down in watts (w).

Outline of study timeline

Day 1: Day of introductions, collection of data consent and recording of initial ore testing.

Day2 – Day 6: Loading Phase, 20g/day / 4 times a day at (5g)

Day 7: Concluding testing and recording all data sets for further analysis.

Section 3 – The Methodological Limitations

In order to understand the viability and accuracy of this study, several limitations should be considered. In this research, time was a big factor, with the structure of the research making it very difficult to utilize the participants' time effectively. The timely management of the research was greatly affected by this. While conducting research at UWTSD, time was taken into consideration so each testing phase was readily set out for the participants to do the tests, be instructed by the researcher with all the information needed to load the creatine. The participant's timeframe was utilised, this limitation didn't affect the accuracy of the testing and collection of the data.

It is also important to consider participant bias as a limitation. In this case, the bias played a significant role because handpicking different individuals based on trained and untrained individuals would have led to much greater data sets, with the understanding of how each group is affected when consuming creatine. The individuals which were picked were all trained individuals, the data will still be considered accurate and applicable against current research that has done the same, but a much larger group of participants would have allowed the data to be of greater significance.

Participants were also subjected to demographic bias, 83% of participants were Asian British ethnicity, 17% of participants, Caucasian ethnicity. Having a very limited demographic group this will greatly narrow down the use case of the research and only be relatable when comparison to Asian ethnic background. The results however wouldn't be impacted as they still are accurate and relatable. This is because research on creatine doesn't generally focus on a demographic group rather the impact of creatine on performance and other physical and cognitive abilities that creatine can enhance.

The research was conducted in a methodical manner and results were recorded with the upmost accuracy and planning, which will still allow for this research to be held viable and accepted as current in the field of creatine.

To conclude this research focus is to understand how creatine affects strength and power, to do these 2 exercises were picked to measure these effects on a group of people. The study was conducting using evidence-based parameters when considering loading phase and exercises which measure strength and power. Data collected on the participants was a

universal standard for distinguishing participants' physiological state. Step by step of the research testing phase was maintained with rigorous standards to uphold the reliability and accuracy of test results. The understanding of limitations that were faced during the research was analysed and attacked to increase the standards of results on validity of the research.

Results

A total of 6 participants completed both the pretesting sessions and the post testing sessions which was separated by 5 days gap between. Age, height, weight, body fat and muscle were all recorded at the pretesting.

Table 1.1:

Column1	Age	Height cm	Weight kg	BMI	Body Fat %	Muscle %
Subject 1	22	178.5	90.4	27.6	27.4	68.9
Subject 2	22	173.5	126.4	41.4	38	58.9
Subject 3	23	164.3	66.6	23.6	16.5	79.3
Subject 4	18	172.1	90	29.1	27.4	69.1
Subject 5	25	177	135	42.1	35.9	60.9
Subject 6	57	180	79.2	24.4	10.2	85.3

Table 1 contains the anthropometric characteristics of the participants in this research.

Column1	PeakPower w (Pre)	1RM kg (Pre)	PeakPower w (Post)	1RM kg (Post)	Change in PP w	Change in 1RM kg
Subject 1	359.5	65	378.5	70	19	5
Subject 2	321	90	336	95	15	5
Subject 3	161.5	75	169.5	75	8	0
Subject 4	230	77.5	244.5	80	14.5	2.5
Subject 5	254	95	265	102.5	11	7.5
Subject 6	180.5	60	194	60	13.5	0

Table 1.2:

Table 2 presents the data recorded during the 1RM and peak power exercises. The table also displays the change between the pretesting and the post testing phases of the research. From the table we can see an increase in both exercises, certain individuals like subjects 3 and 6 didn't display any increase in 1RM but increases in peak power were visible.

Table 2 presents the change in 1 RM in kg, there was an average of 3.33 kg increase across the subjects. Peak Power had an average of 13.5 w increase overall across the subjects.

Subject 1: Peak Power increase 5.2%, 1RM 7.6% increase

Subject 2: Peak Power increase 4.6%, 1RM 5.5% increase

Subject 3: Peak Power increase 4.9%, 1RM 0% increase

Subject 4: Peak Power increase 6.3%, 1RM 3.2% increase

Subject 5: Peak Power increase 4.3%, 1RM 7.8% increase

Subject 6: Peak Power increase 7.4%, 1RM 0% increase

From Figure 1.1 we can see an average increase of 5.45% in Peak Power chest press. From Figure 1.2 we can see an average increase of 4.01% from 1RM bench press test. The results display an increase in both 1RM and Peak Power chest press.

Figure 1.1:

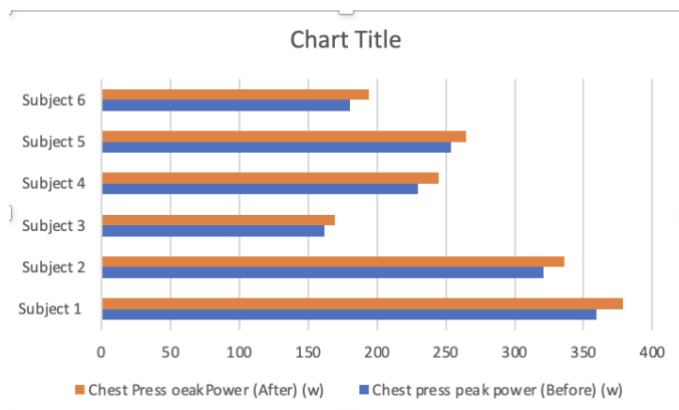


Figure 1.1 displays the peak power data for pre and post testing.

Figure 1.2:

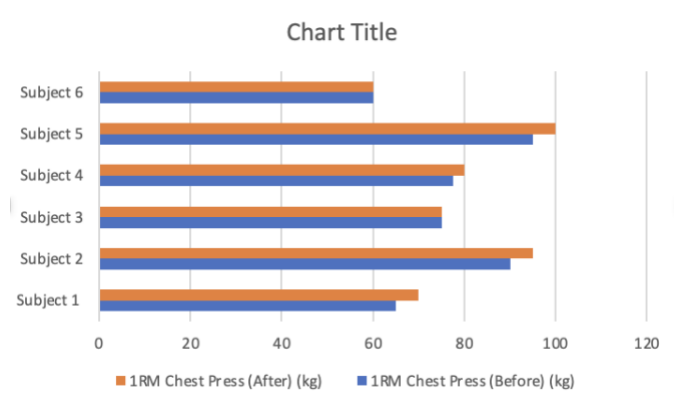


Figure 1.2 displays the 1RM data for pre and post testing.

Discussion

In this study, creatine loading was investigated in relation to a person's ability to show enhancements when supplementing creatine by performing power and strength exercises. In more detail, how creatine will affect a person's strength and power when performing exercises like a 1RM and Peak Power chest press. As part of the study, participants were to be tested in 1RM for strength and Keiser chest press for peak power to determine whether loading creatine after a rapid loading cycle would increase strength and power. In order to build a more concrete picture and understanding of how creatine really affects these parameters, more data is essential to increase the validity of creatine's power and strength enhancements. Using a rapid loading phase, this hypothesis for this research was supported and establishes the theory on creatine finding justified data that supports the claim that creatine increases both power and strength respectively when supplementing and using a 5-day rapid loading phase.

Creatine is a major enhancing agent when supplementing and has proven to increase both strength and power in many studies conducted. Previous research also shows that creatine supplementation increases power output through improved ATP regeneration, since it increases the Phosphocreatine pool within the muscle fibres, (Gastin, 2001). Study by, (Law et al., 2009) found that creatine supplementation for enhanced strength and power requires the 5-day loading regime. The study found that a 5-day creatine loading program combined with resistance training results in significant improvements in both anaerobic power and back squat strength compared to just training alone.

The purpose of this study was to determine how creatine loading using a 5-day rapid loading cycle will affect the power and strength output of each participant. Using a combination of loading and testing, we found that creatine loading for five days at 20g a day, spread out over four times a day, increased strength by testing with a 1RM and power using the Keiser pneumatic resistance machine. The results indicate a growth in both strength and power increased at 5.45% for peak power and 4.01% for 1RM following a 1-week testing period. Looking at individual results, there was growth on 1rm as much as 7.8% and power increases at 7.4%. The increase in both power and strength were respective of each other. The results of this research supported the hypothesis and confirmed that creatine loading does indeed increase strength and power.

There is no doubt that creatine supplementation allows athletes to train harder over time, and studies show that it may improve peak performance in the short-term. A study which was trying to determine whether oral creatine loading could enhance the performance of single and repeated short sprints. Researchers have found that creatine supplementation (20g/day/1 for five days) significantly increases peak power during the first set of sprints performed on a cycle ergometer, according to, (Dawson et al., 1995). Although this research is over 25 years old, the data from this research is still valid and indicates its increased power from short term loading of creatine at a duration of 5 days.

Another study looked at how twenty-three male volunteers with at least 1 year of weight training experience participated in an investigation by (Becque et al., 2000). The researchers tested arm flexor 1RM, upper arm muscle area, and body composition. For five days, subjects consumed 20g of creatine supplementation a day, then 2g a day after that. Compared with strength training alone, 6 weeks of creatine supplementation during arm flexor strength training led to greater increases in upper arm muscle area, arm flexor muscular strength, and fat-free mass. This research used a training regime combined with a maintenance phase to analyse how creatine will affect the strength in the upper arm region of the body and found that increased maintenance of creatine during the training led to much greater increases in strength indicating that adopting a maintenance phase after a loading creatine will make the supplementation of creatine more effective.

Adding creatine supplementation to a power athlete's diet may improve work performance during maximal effort muscle contractions, one of the most beneficial effects. Researchers (Volek et al., 1997a) found that creatine supplementation (25 grams "day-one" for 7 days) improved exercise performance when compared with a placebo group during five sets of bench press and jump squat exercises. Set 2 of bench press saw a significant increase in repetitions, while set 5 of jump squats showed a significant increase in peak power output. As pre- and post-exercise testosterone and cortisol values were not significantly different between groups, the authors concluded that increases in exercise performance and body mass (1.3 kg) are not due to any change in circulating steroid hormone concentrations. The peak power output of the jump squat also increased by 4.7% and 26.6% when creatine supplementation was extended by 11 days (Volek et al., 1997b). research is indicating that an increase in the availability and resynthesis of energy substrates is most likely responsible for the improvements.

A study by, (Casey et al., 1996) conducted testing for five days, nine male subjects performed two bouts of maximal isokinetic cycling for 30 seconds before and after ingestion of 20 g creatine (Cr) monohydrate. Both peak and total work production increased over the two exercise bouts by approximately 4%, and the increase in muscle total creatine was positively correlated with the increases in peak and total work production.

During the testing one participant performed unexpectedly compared to the rest of the testing group. Results indicated low increases in power and no increase in strength even after following the same protocol as the other participants. Looking at different research it has been reported that maximal strength increases when creatine supplementation is taken for 5–7 days (Law et al., 2009), (IZQUIERDO et al., 2002), (Urbanski et al., 1999). In addition to the type of maximal strength test used, Izquierdo and colleagues (IZQUIERDO et al., 2002), found that these improvements were also influenced by the type of assessment. An increased impact on the phosphagen system is implied by a longer contraction time, (Maughan, 1995). Studies that have measured maximal strength using isometric contractions lasting up to 3–5 seconds or repetition trials of 1RM (3–4 repetitions per load) may have found an increase in maximal strength, (Urbanski et al., 1999). Contrary to previous studies, this study utilized a single-repetition protocol with maximum velocity for each repetition. Further consideration should be given to individual characteristics. Due to diminished phosphocreatine storage or no previous experience with creatine supplementation, some subjects respond differently to creatine supplementation. Due to lower adaptation capacities, subjects who have previously taken creatine supplements perform differently from those who haven't, (Casey & Greenhaff, 2000). Only trained subjects who had previously consumed creatine supplements were included in the present study in order to minimize these effects, (Feuerbacher et al., 2021). As a result, people with more experience in strength workouts and power exercises will have different results compared to those with no experience.

Although there have been implications of weaknesses in the research during the testing and literature review, the overall accuracy of the data is not hampered, but there are some areas where precautions and rigorous control of the study could have strengthened the research. In the loading phase, creatine doses were given to participants to administer on their own. There was no instruction on how to use the supplement other than to divide daily doses into four. Due to the small sample size, generalisability was also affected during this study. The data set is only applicable to a narrow group of people, since the sample size was too small to be able

to be used as a reference. The study would have been more representative if a large and broader sample size had been used, which would have further enhanced generalisability.

Studies also show that the use of a training regime while loading has been shown to increase strength and power during testing. However, the timing of the research prevented introducing a regime, so instead the research continued with loading and testing for differences between pre- and post-testing phases. Participants were asked to continue with their level of exercise as normal, an introduction of a training strategy would have allowed a more controlled study and understanding of how certain exercises would have enabled a better view of the use case of creatine. This study did not adopt a maintenance phase due to availability and consistency of keeping track of creatine ingestion of subjects during the study, which is another limitation which could have been addressed. This study didn't adopt a test with 2 groups which could have given 2 sets of results for analysis. Researchers often use two groups to obtain data: a placebo group and a group that consumes creatine in a loading phase followed by a maintenance phase. As a result of the research, both groups perform the same training regimen and take either creatine or placebo, and the two sets of data are analysed. By comparing the data between the placebo group and the group which took creatine, it will be possible to determine how creatine affected performance and ability.

There may be a reason for the conflicting results in the experiment examining the effects of creatine supplementation on exercise performance. An ordered treatment allocation or a cross-sectional experimental design has been used in most studies. The time needed for muscle total creatine to return to basal levels after creatine supplementation may explain why few studies have used a crossover design. Research by (Lemon, 2002), points out that an interpretation of existing creatine literature is extremely difficult due to several factors, including, but not limited to, sample size, exercise modality, rest and recovery intervals, residual effects of cessation of creatine supplementation, non-responders, gender and age effects, as well as the methodology used. In the future, researchers might investigate how different loading phases affect power and strength measurements in specific exercises. In order to gain a more thorough understanding of how creatine affects various types of movements and exercises when loading, the research needs to be refined by using a variety of loading phases, adopting a variety of training regimes, and using larger groups to obtain a more representative sample. In future studies, limitations could be used as advantages to

improve understanding of how creatine supplementation affects performance and enhances a person's capabilities.

Research on creatine has found that during rapid loading phases there has been data to show that the level of power has shown to increase by 5-15%, studies have indicated that creatine provides strength and power in the range of 5-15%, (Kreider, 2003). This research has looked at how creatine affects strength and power while adopting a rapid loading phase of 5 days. The research has indicated that rapid loading at 20g/day 5g/4 times a day does increase the level of strength and power, the study uses a bench press exercise and uses the Keiser pneumatic power machine as tools to measure these parameters. This research has found that creatine has increased strength and power by 4 -5.45%, with gains as much as 7.8%.

Conclusion

The effects of creatine supplementation have attracted the attention of athletes and scientists in recent years. Researchers say that the creatine found in meat and fish improves performance during brief, intense exercise, just like when glycogen limits performance, dietary carbohydrates act as a substitute. A short-term (a few days) supplementation increases phosphocreatine stocks, accelerates phosphocreatine resynthesis after exercise, improves ATP production during glycolysis by increasing hydrogen ion buffering, and/or shortens the time it takes to relax after muscle contractions, according to the mechanisms underlying the ergogenic effect of short-term supplementation. Creatine is indeed capable of directly modifying protein metabolism after weeks or months of loading coupled with a training regimen. This then has ergogenic effects on performance like strength and power. Studies have shown that the effect of creatine can be seen in as short as 5 days after loading, with increases in performance. This research enabled us to see short term loading has an effect when supplementing for enhancement purposes. This study has shown increases of 5.45% in power output and 4.01% in strength output. Peak power increases ranged from 4.3% to 7.4% output and strength ranged from 3.2% to 7.8% output during testing. The aim of the research was to find out how a short-term rapid loading phase of creatine will affect the output of both strength and power.

The main objective of this study was to investigate how creatine affects power during peak power chest press and 1 rep max bench press. Additionally examine the effects of a 5-day loading phase on power and strength during these exercises. Assessing the short-term effects

of creatine on strength and power. The purpose of this study was to explore the effectiveness of short-term gain from creatine and compare it with the previously researched theory of creatine. Although all participants did not produce higher strength outputs after loading with creatine, all showed an improvement in power output after loading with creatine. The major conclusion of this research is that creatine does affect strength and power when used in a short-term loading strategy. A 5-day loading phase of creatine has already been proven to improve strength and power, and this study adds more data to this pool of already proven results.

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