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The Effects of Creatine Monohydrate Supplementation on Anaerobic Performance

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ABSTRACT

Multiple studies have been conducted on the effect of creatine monohydrate supplementation on muscular strength. However, evidence of the effect of creatine supplementation on anaerobic performance is less clear. **PURPOSE:** To determine if creatine supplementation impacts sprint speed and vertical jump height. **METHODS:** 10 females and 9 males (N=19) aged 21 ± 0 from the College of Saint Benedict and Saint John's University participated in this randomized single blind study. Participants ingested creatine monohydrate or a placebo for 21 days and were tested on days 1, 6, 14, and 21. Day one tests were completed prior to the consumption of creatine or a placebo. Each test day participants completed three vertical jump tests and two 30-meter sprints. For both assessments the best result was used. **RESULTS:** Participants ingesting creatine were not found to have improved anaerobic performance within sprints or jumps compared to participants ingesting the placebo. There was a significant main effect of time ($p = .039$) found for sprint time with both groups combined. Simple main effects showed a significant decrease in sprint time in the treatment group ($p < .05$) however, no significance was found between the control and treatment groups ($p = .091$). There was not found to be a main effect of treatment ($p = .402$), time ($p = .069$), or treatment*time interaction ($p = .423$) for vertical jump height. **CONCLUSION:** Creatine supplementation significantly decreased sprint speed, however, there wasn't a significant difference from the control group. Creatine supplementation did not significantly impact vertical jump height.

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Introduction

Supplementations have become increasingly popular over the last few decades and continue to be used by individuals all over the world to benefit workouts. Although much research has been conducted, more is needed to understand how these supplements work and how effective they are. The bioenergetics of anaerobic exercise is important in understanding how to test anaerobic performance as a whole. One major concept in anaerobic exercise is Adenosine triphosphate, ATP, and understanding how it is made and how it is used. ATP is an important molecule in all living things that the body uses for energy (Harris, 2022). This energy allows for the function in many processes within cells making it so crucial for our bodies in everyday life.

Creatine is an important organic acid also having to do with anaerobic exercise. Creatine is stored within our skeletal muscles as well as partially in the heart, brain, and testes. This organic acid can be used for energy so that ATP stores can stay full while creatine stores deplete but will refill from supplements or diet. When supplementing with creatine, a loading and maintenance phase can be beneficial for better results in performance during physical activity. Creatine becomes phosphorylated by ATP creating creatine phosphate, which is the main source of intramuscular energy (Ransonea, 2002). Creatine can also be used in the energy transport vehicle to make ATP, giving the body more energy to use (Ransonea, 2002). The loading phase of creatine supplementation involves taking around 20 grams of creatine a day for about six days (Ransonea, 2002). Following that, an individual must maintain creatine stores by taking about 2 grams a day for the time period after the loading phase (Ransonea, 2002). These phases help to increase the amount of creatine in the body for the longest period of time, helping performance increase with optimal results. Some safety concerns have been brought up concerning creatine supplementation, although no studies have found any of these concerns to be valid.

Multiple studies on the effects of creatine supplementation have been conducted over the years, in which a range of different results were found (Boyadjiev, 2007; Delextrat, 2020; Theodorou, 2017; Yáñez, 2017). Some of these result findings show that creatine supplementation has been found to improve anaerobic performance, exercise performance, peak power input, and mean power output. All these studies were conducted under reliable methods, materials, measures, and subjects. Conversely, studies have shown that creatine supplementations are ineffective in increasing performance. Researchers have also found a decrease in fatigue after physical activity when being supplemented with creatine. This finding is inconclusive to the researcher's hypothesis because it lacks to prove findings of any benefits from creatine supplementation within the data. Overall, more evidence has proven creatine supplementation to benefit exercise performance and muscle strength and endurance than not (Edwards, 2000; Hoffman, 2005). However, continued research was necessary to examine the effects of creatine monohydrate supplementation on anaerobic performance specifically. This hypothesis stated that if individuals ingest creatine monohydrate as a supplement, they will have increased anaerobic performance. The purpose of this study is to determine if creatine supplementation impacts sprint speed and vertical jump height.

Methods and Materials

Testing took place at the College of Saint Benedict in the field house and the exercise and health sciences lab. This study was approved by the institutional review board. The participants were recruited through campus email and word of mouth. The population consisted of 10 female and 9 male participants that were enrolled at the College of Saint Benedict and Saint John's University with physical characteristics shown in Table 1.

Table 1. Physical Characteristics of the subjects. Values are means ± SD; *n* = number of subjects.

	Male (*n* = 9)	Female (*n* = 10)
Age (years)	21 ± 0	21 ± 0
Height (cm)	164.7 ± 5.2	153.5 ± 4.8
Weight (kg)	80.6 ± 11.6	72.3 ± 7.6

This study was conducted as a randomized single blind study where participants were given either creatine monohydrate or a placebo. Supplementation was dispersed on an every other scale per sex. Participants were given an incentive of a 15-dollar amazon gift card to complete this study. Participants that were recruited engaged in at least 150 minutes of moderate aerobic exercise per week prior to participating in this study. The participants had eaten and had at least 18 oz of water within an hour prior to coming into testing. The participants participated in a 10-minute dynamic warm up that consisted of stretching, high knees, butt kicks, and other simple warmup exercises. Prior to testing on the first day, all participants learned when and how to take creatine, and the loading and maintenance phase was explained thoroughly. For the first six days of the study, participants ingested eight pills that had 2.5 grams in each to make a total of 20 grams of creatine or placebo each day (Edwards, 2000). Then on day 7 to 21 participants started taking two pills that had 2.5 grams in each to make a total of 5 grams a day (Edwards, 2000). The amount of creatine ingested was based on the most common amounts used for the loading and maintenance period (Edwards, 2000). The creatine used was ‘Optimum Nutrition Micronized Creatine Monohydrate Capsules’. The placebo consisted of capsuled potato starch.

Participants in this study were able to take the capsules they were given at any time of the day. The participants were tested on day 1 prior to having taken any creatine or placebo supplementation. Participants were then tested on the last day of the loading phase, which was day 6. Lastly, they tested two more times throughout the maintenance phase, on days 14 and 21. Participants height was measured only on the first day. The testing consisted of two sets of 30 m sprints, in which the fastest was recorded, and three sets of vertical jump tests, in which the highest was recorded. Sprints and vertical jumps were used as an assessment for this study because they are shown to accurately portray anaerobic performance (Mangine, 2014). Each testing session the participants weight was taken using a Befour Incorporation portable platform scale. This is a professional scale that has concluded to give reliable and valid results with ± 0.1 lb. accuracy (Products, n.d.). The vertical jumps were conducted on the Just Jump Probotics Incorporation vertical jump mat at the exercise and health sciences lab. This vertical jump mat has been found to be valid and reliable (Just Jump, n.d.). The sprint tests were conducted on an indoor track. In between each sprint, there was a one-minute passive recovery time. The data was analyzed using an independent groups design, repeated testing, two x four, mixed ANOVA test.

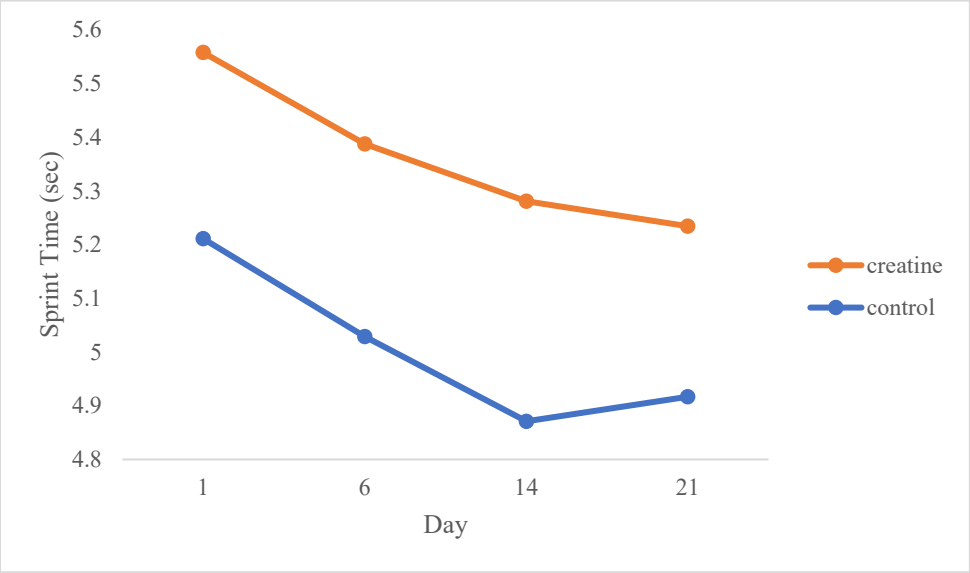
Results

Analyzed data showed there to be no significant difference between the treatment and control groups ($p = .091$). Participants ingesting creatine were not found to have improved anaerobic performance within sprints or jumps compared to participants ingesting the placebo. There was a significant main effect of time ($p = .039$) found for sprint time with both groups combined. Simple main effects showed a significant decrease in sprint time in the treatment group ($p < .05$) however, no significance was found between the control and treatment groups ($p = .091$). There was not found to be a main effect of treatment ($p = .402$), time ($p = .069$), or

treatment*time interaction (p = .423) for vertical jump height. Overall, the results show improvement over time in both tests for both groups and improvement for the creatine group during sprint tests, but no improvement in jump height for individuals ingesting creatine monohydrate compared to ingesting the placebo.

Figure 1.

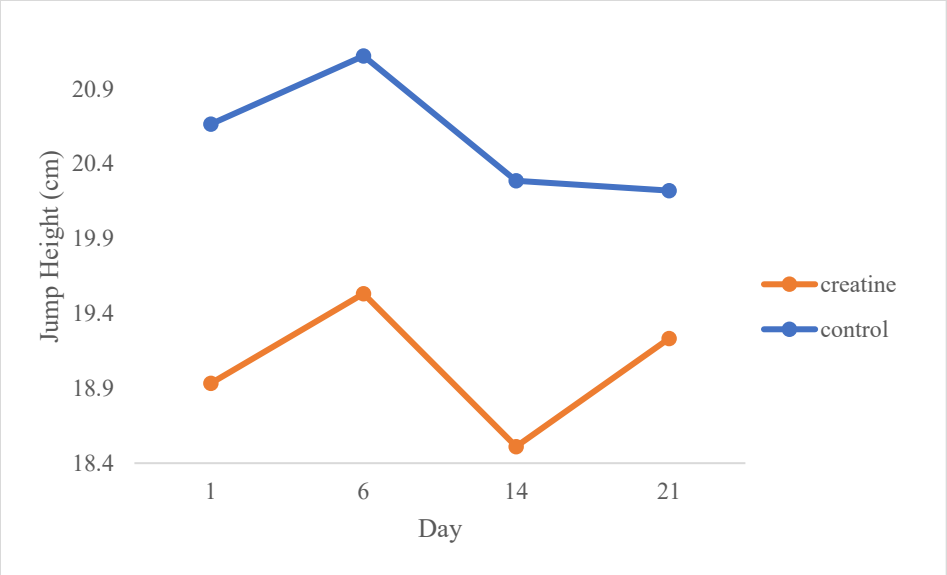
Average Sprint Times Over Each Test Day



Note. This figure demonstrates the mean values of sprint times of each test day.

Figure 2.

Average Jump Height Over Each Test Day



Note. This figure demonstrates the mean values of jump height of each test date.

Discussion

A multitude of studies have been conducted on the effects creatine has on exercise performance, however, the effect on anaerobic performance remains unclear. The results of this study found no significant difference on anaerobic performance between control and group receiving creatine, which is in contrast to others (Boyadjiev, 2007; Delextrat et al. 2020; Yáñez, 2017). A study by Delextrat et al. (2020) evaluated the effects creatine had on anaerobic exercise. In this study, 44 male and female racket sport players performed 10 repetitions of six second sprints with departure every 30 seconds before and after a 28-day supplementations period. There were four groups, one that received creatine, one that received beta alanine, one that received both, and one that received a placebo. Peak and mean power, performance decrement, heart rate, blood lactate concentration, and perceived exertion were all measured. A significant increase in peak power was found after the 28 days in both the creatine and beta alanine groups. No additional benefits of combining creatine and beta alanine were found. The

evidence from this study shows the benefit creatine supplementation has on anaerobic performance (Delextrat, 2020).

Similar to the results of the present study, studies have found that creatine is ineffective in regard to increasing anaerobic performance (Edwards, 2000; Hoffman, 2005). Edwards (2000) conducted a study on the effects of creatine supplementation on an anaerobic performance. Twenty-one moderately active men were given either a creatine or a placebo supplement for six days. The participants did four 15 second bouts of high intensity treadmill running. The tests were separated by 30 seconds of passive recovery. The data found there were no significant treatment effects in AST performance, body mass, or blood lactate. Researchers found a significant interaction for decreased plasma ammonia in the post creatine group. This data shows creatine supplementations is ineffective in increasing performance in repeated short term, high intensity anaerobic running (Edwards, 2000).

Multiple limitations were present over the course of this study. One potential limitation is due to the fact that participants did not engage specifically in sprints or vertical jumps prior to the tests. So, participants may have improved test scores over the course of the study simply from starting to engage in these exercises. Another limitation was the time-of-day participants were tested. Because all participants were college students with busy schedules, tests were taken at any time throughout the day. This could have potentially caused discrepancies in data due to if or when participants had eaten, how tired they were, and how much effort they were willing to put into the tests. Lastly, the sample size of the study was fairly low (n=19), which may have contributed to lack of significance.

Future research can be done on anaerobic performance with different supplementations, such as beta-alanine, as one example. Research can also be done on the effects creatine

supplementation has on muscular endurance. While evidence on muscular strength gains with creatine supplementation is relatively strong, it remains unclear the impact creatine supplementation has on muscular power, anaerobic performance, and muscular endurance. All of those concepts should be a part of future research. This research study can lead to many other research studies to be held in the future.

Conclusion

In conclusion, this study showed that creatine supplementation has a significant main effect of time found for sprint time with both the creatine and control group combined. This study also showed a significant decrease in sprint time in the treatment group. However, no significance was found between the control and treatment groups. The current study both compared and contrasted from previous research findings. From these results, it is unclear whether creatine supplementation has an effect on anerobic performance. Further investigation is needed to determine whether creatine supplementation increases anaerobic performance.

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