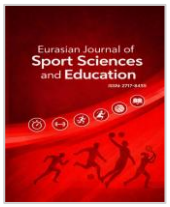
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Research Article

Creatine Supplementation Combined with Carbohydrate Restriction Before Competition in an Elite Female Long Jumper: A Case Study

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Abstract

Jumping events in athletics (long jump, triple jump, high jump, pole vault), 60 m (indoor) and 100 m sprints, as well as vault in artistic gymnastics, last up to 10 s, require strength and speed in combination with low relative body weight. Excess body mass may negatively affect performance, and the main energy source for these disciplines is creatine phosphate. Consequently, creatine supplementation has an expected positive effect, but creatine is also associated with a particular increase in body mass, on average by 0.8 – 1 kg, according to various authors. This weight gain is at the expense of some muscle fluid retention. Another factor for increasing muscle fluid is glycogen, but glycogen reserves do not play a significant positive role in the sports disciplines listed. Therefore, the aim of this exploratory case study was to describe the effects of short-term creatine supplementation combined with carbohydrate restriction in an elite female long jumper before competition. One week before a main competition, the athlete reduced carbohydrate intake to a minimum and supplemented with 4 x 5 g/day creatine monohydrate. A 30-s continuous jump test on a force plate system was performed before and after the study intervention, and the athlete's body mass was monitored throughout the week. In this case study, the results showed no changes in body mass and a significant increase in maximal rebound (48.9 cm vs 41.36 cm) and jumping endurance. Moreover, the athlete's performance at the competition was the best result in her career – 6.5 m against a maximum of 6.4 m in previous events. This supplementation regimen requires further investigation with a sufficient number of participants to confirm its effectiveness.

Keywords: Creatine, long jump, performance, supplements

INTRODUCTION

Jumping events in athletics, including the long jump, triple jump, high jump, and pole vault, as well as short sprint events such as the indoor 60 m and outdoor 100 m, are characterized by very short performance durations and a high reliance on explosive neuromuscular qualities (Gastin, 2001; Suchomel et al., 2016). Similarly, vaulting in artistic gymnastics requires the athlete to generate high approach velocity, produce force rapidly during take-off, and control the body effectively during flight and landing (Schärer et al., 2019). These events are predominantly associated with speed, maximal and reactive strength, explosive power, technical efficiency, and a favorable power-to-mass ratio rather than endurance capacity (Morin et al., 2012; Suchomel et al., 2016). From a physiological perspective, such short-duration maximal efforts mainly depend on the rapid availability of energy through anaerobic pathways, particularly the ATP-PCr system (Gastin, 2001). From a biomechanical perspective, successful performance depends on the athlete's ability to generate large forces in very short contact times and to effectively apply force in the direction of movement, which is especially important in sprinting, take-off, and vaulting actions (Morin et al., 2011; Morin et al., 2012; Schärer et al., 2019). Therefore, athletes competing in these events generally benefit from high levels of relative strength and power, low non-functional body mass, and efficient movement mechanics, all of which contribute to rapid acceleration, effective take-off, and optimal flight performance (Hirsch et al., 2016; Suchomel et al., 2016).

Excess body mass is a negative factor for sports performance, and the primary energy source for these disciplines is creatine phosphate. Consequently, creatine supplementation is expected to have a positive effect, but it is also associated with a specific increase in body mass. A recent review, which included 143 studies (36,055 participants) on creatine supplementation at various doses and durations, showed a relatively consistent average body mass increase of 0.86 kg (0.76 to 0.96 kg) (Pashayee-Khamene et al. 2024). This weight gain comes at the expense of some muscle water retention. Another factor contributing to

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increased water in muscles is glycogen, as 1 g of muscle glycogen retains 3 g of water (Fernández-Elías et al., 2015). Glycogen reserves do not significantly enhance performance in high-intensity exercises lasting up to 10 seconds.

Creatine monohydrate is one of the most widely investigated ergogenic supplements and has been shown to support high-intensity exercise performance, particularly in activities that rely heavily on the phosphocreatine energy system (Kreider et al., 2017; Wax et al., 2021). Its reported benefits include improvements in strength, power, repeated high-intensity exercise capacity, and recovery, which are relevant to explosive events such as jumping and sprinting (Kreider et al., 2017; Wax et al., 2021). However, in events where relative body mass is important, even a small increase in body mass may be considered undesirable by athletes and coaches. For this reason, strategies that aim to obtain the potential performance benefits of creatine while limiting unnecessary body mass gain may be practically relevant in weight-sensitive explosive sports.

Therefore, the aim of this exploratory case study was to describe the effects of short-term creatine supplementation combined with carbohydrate restriction on jump performance in an elite female long jumper before competition.

METHOD

Research Group (Population-Sample)

The subject of this case study was a Bulgarian Women's National long jump champion, 29.0 years of age with 19 years of sports experience. Her height was 165.0 cm, and her weight was 60 kg, with an official personal long jump record of 6.40 m up until the beginning of this study. One week before the main competition, the athlete was required to reduce carbohydrate intake to the lowest practically achievable level while maintaining her usual protein and fat intake, and to supplement with 4 × 5 g/day of creatine monohydrate. The dietary intervention was applied in a real-world pre-competition setting and was not based on weighed dietary records; therefore, exact carbohydrate intake in g/kg/day was not available.

Data Collection Tools

A 30-second continuous jump test (30sCJT) (Dal Pupo et al., 2014) on a Contact platform DIN-A2 420 x 590 mm (Chronojump, Spain) was performed at the beginning (Test1) and the end (Test2) of the creatine supplementation period. The warm-up included the following: 5 minutes of light jogging, 5 minutes of stretching, 2 maximal jumps, and 5 minutes of passive rest. The test protocol required the athlete to jump vertically with maximal effort on the platform for 30 seconds. The knee joint during the push-off phase was at a 90º angle with hands on the hips throughout the 30sCJT. Continuous feedback regarding her knee flexion during the push-off was provided to the athlete. Lactate was measured in capillary blood from the earlobe after the warm-up and 3 minutes after the end of the 30sCJT using LactatePro2, Japan. Seven skinfolds (Jackson & Pollock, 1980) were measured using a Lange Caliper, and BF% was calculated before Test1. Arm, thigh, and calf circumferences were measured with Lufkin W606PM tape, and muscle mass was calculated (Lee et al., 2000). The athlete's body mass was measured throughout the week of creatine supplementation.

Data Analysis

Descriptive statistics and Student's paired T-test between Test1 and Test2 average jump height were conducted by SPSS 22 (IBM, USA).

FINDINGS

The results from the anthropometric parameters, jump test, and lactate at the beginning and one week after the intervention are presented in Table 1. At the beginning of the creatine supplementation week, the athlete's body mass was 60.0 kg, and it remained almost the same at the end of the intervention (Table 1). Body fat decreased slightly (-2.4%), and muscle mass increased by 1.2%. The athlete also improved her performance in the 30sCJT concerning both maximal and average height. Lactate values showed a 20% decrease in the test after the creatine supplementation week.

Table 1. Measured parameters at the beginning (Test1) and one week later (Test2)

Variables	Units	Test1	Test2	Difference%
Body mass	kg	60.0	59.9	-0.2%
Body fat	%	8.5	8.3	-2.4%
Muscle mass	%	43.1	43.6	1.2%
Muscle mass	kg	25.8	26.1	1.2%
Jumps	number	28	26	-7.1%
Maximal jump height	cm	41.4	48.9	18.1%
Average jump height	cm	35.8 ± 3.8	39.7 ± 4.8*	10.9%
Lactate before	mmol/L	1.3	1.4	7.7%
Lactate 3 min after	mmol/L	4.7	3.6	-23.4%

*= $p < 0.001$ vs Test1

In addition to the maintenance of body mass, the athlete demonstrated improvements in both maximal and average jump height after the intervention. Maximal jump height increased by 7.5 cm, from 41.4 cm in Test1 to 48.9 cm in Test2. Average jump height increased by 3.9 cm, from 35.8 ± 3.8 cm to 39.7 ± 4.8 cm, despite a reduction in the total number of jumps from 28 to 26. These results indicate that the post-intervention test was characterised by higher jump quality rather than a greater number of jumps.

The results from the maximal jump height of the 30s CJT are presented in Figure 1. The athlete demonstrated a clear improvement in her jump performance, with her maximum attempt reaching 48.9 cm, which was an 18% increase from the one at the beginning of the intervention. The figure shows that nearly all of her attempts reached a better score on Test2.

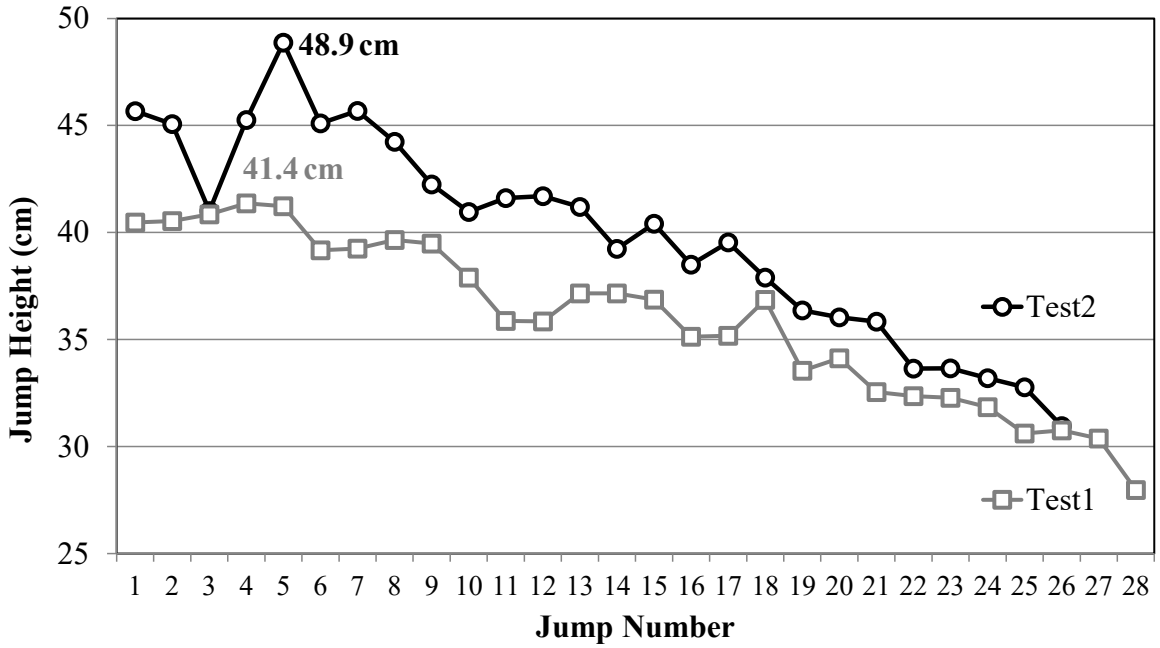


Figure 1. Results from 30s CJT at the beginning (Test1) and one week later (Test2)

Moreover, the athlete's performance at the competition was the best result of her career – 6.5 m compared to a maximum of 6.4 m in previous events.

DISCUSSION AND CONCLUSION

The present exploratory case study showed that short-term creatine monohydrate supplementation combined with carbohydrate restriction was followed by maintenance of body mass and improvements in maximal and average jump height during the 30sCJT in an elite female long jumper. These findings are practically relevant because creatine supplementation is widely recognised as an ergogenic aid for high-intensity exercise performance, particularly in activities relying on the phosphocreatine energy system (Kreider et al., 2017; Wax et al., 2021). However, body mass gain is commonly reported following creatine supplementation, and this may be undesirable in explosive events where relative body mass is important (Pashayee-Khamene et al., 2024). In the present case, body mass remained almost unchanged during the intervention period, which may be partly explained by the restriction of carbohydrate intake and the associated reduction in glycogen-related water retention.

The link between glycogen and body water is important for interpreting the present findings. Fernández-Elías et al. (2015) demonstrated the close relationship between muscle glycogen recovery and muscle water content after exercise. Similarly, Murray and Rosenbloom (2018) highlighted the practical importance of glycogen metabolism for athletes and coaches, including the role of carbohydrate intake in restoring glycogen stores. More recently, Shiose et al. (2022) reviewed the relationship between muscle glycogen assessment and body hydration status, showing that glycogen manipulation may influence body water and body composition measures. Therefore, the present case is supported by the physiological rationale that reducing carbohydrate intake before competition may limit glycogen-associated water storage, which could help maintain body mass during short-term creatine supplementation. Nevertheless, this interpretation remains speculative because muscle glycogen and hydration status were not directly measured in the present study.

The improvement in maximal jump height from 41.4 cm to 48.9 cm (Figure 1) represents a meaningful change in explosive performance in this athlete. The increase in average jump height also suggests that the athlete was able to sustain higher-quality efforts throughout the 30sCJT. These findings are consistent with previous literature showing that creatine may support strength, power, repeated high-intensity exercise capacity, and recovery (Kreider et al., 2017; Wax et al., 2021). In addition,

recent research on repeated sprint performance supports the potential role of creatine in short-duration, high-intensity activities. Glaister and Rhodes (2022), in a systematic review and meta-analysis, reported that short-term creatine supplementation may improve mean power output during repeated sprint tests. Bogdanis et al. (2022) also reported improved power output during repeated treadmill sprinting after creatine supplementation. Although long jump performance is not identical to repeated sprinting, both activities require rapid force production, high power output, and short-duration anaerobic energy supply. Therefore, the present findings are in line with the broader evidence that creatine may benefit explosive and repeated high-intensity actions.

Although the total number of jumps decreased slightly from 28 to 26, both maximal and mean jump height increased after the intervention. Since maximal and mean jump height are commonly used outcomes in the 30-s continuous jump test to reflect anaerobic power and repeated explosive ability (Dal Pupo et al., 2014; Čular et al., 2018), this pattern may suggest an improvement in jump quality rather than an increase in jump frequency. However, this interpretation should be made cautiously, as a lower number of jumps may also reflect changes in pacing strategy, ground contact time, fatigue management, or movement coordination. From a long jump perspective, this finding may be practically meaningful because competitive performance is largely dependent on the ability to generate effective take-off velocity, particularly by increasing vertical velocity while minimizing the loss of horizontal velocity (Linthorne, 2008; Yang et al., 2023). Nevertheless, the 30-s continuous jump test does not fully reproduce the technical and neuromuscular demands of the long jump, including approach velocity, board accuracy, single-leg take-off mechanics, flight control, and landing technique. Therefore, the laboratory findings should be interpreted as complementary evidence of repeated explosive ability and considered together with the competitive result, rather than as a direct predictor of long jump performance.

The role of carbohydrate restriction should also be interpreted carefully. The present strategy was designed for an explosive event lasting only a few seconds, where phosphocreatine availability and low relative body mass may be more important than high glycogen availability. Henselmans et al. (2022) reported that carbohydrate intake does not consistently improve strength or resistance-training performance, particularly in lower-volume conditions, although carbohydrate availability may become more important in higher-volume or glycogen-depleted contexts. This supports the idea that short-term carbohydrate restriction may be less detrimental for very brief explosive efforts than for longer or repeated high-volume exercise. However, carbohydrate restriction could be disadvantageous in events requiring prolonged glycolytic contribution, repeated rounds, or multiple competition attempts with insufficient recovery. Therefore, the approach described in this case should not be generalised to all athletes or all sports.

Conclusion

The decrease in post-exercise lactate should be interpreted cautiously. It may reflect altered glycolytic contribution under reduced carbohydrate availability, improved phosphocreatine contribution, or differences in pacing during the test; however, these mechanisms cannot be confirmed from the present single-athlete case study. This point is important because lower lactate values do not necessarily indicate improved metabolic efficiency. In the context of carbohydrate restriction, lower lactate may also reflect reduced glycolytic substrate availability. Therefore, the lactate response should be considered supportive but not conclusive evidence regarding the mechanism of performance change.

The athlete's subsequent personal best of 6.5 m in elite competition provides useful applied context, although it should not be interpreted as proof of causality. Competition performance is influenced by many factors, including technical execution, psychological readiness, environmental conditions, competition pressure, and the athlete's training state. Nevertheless, the combination of maintained body mass, improved 30sCJT performance, and personal best competition result suggests that the intervention did not negatively affect the athlete's short-term performance preparation. This is practically important because athletes and coaches in weight-sensitive explosive events may be reluctant to use creatine due to concerns about body mass gain.

The main scientific contribution of this study is that it documents a real-world pre-competition strategy in an elite female long jumper, combining creatine supplementation with carbohydrate restriction in an attempt to improve explosive performance while avoiding unwanted body mass gain. Elite athletes are difficult to recruit for controlled studies, and case studies can provide useful practical observations that generate hypotheses for future research. The present findings suggest that this strategy may be relevant for selected athletes in weight-sensitive explosive sports, including long jump, triple jump, sprinting, and artistic gymnastics vault. However, the results should be interpreted as preliminary and hypothesis-generating rather than conclusive.

In this exploratory case study, short-term creatine monohydrate supplementation combined with carbohydrate restriction was followed by improved jump-test performance and maintenance of body mass in an elite female long jumper before competition. This approach may be practically relevant for athletes in explosive events lasting up to approximately 10 s, where strength, speed, and low relative body mass are important. The findings are consistent with previous literature on creatine supplementation and high-intensity performance, while also highlighting the possible role of carbohydrate and glycogen-related water management in weight-sensitive explosive sports. However, because this was a single-athlete case study without a control or placebo condition, the findings should be interpreted cautiously. Further research with larger samples and controlled dietary, hydration, glycogen, and menstrual-cycle monitoring is required to confirm whether this strategy is effective and reproducible in other athletes.

Recommendations

This case study suggests that short-term creatine monohydrate supplementation combined with carbohydrate restriction may be a useful strategy for athletes in explosive events where power and low body mass are important. However, this approach should be applied cautiously and only under professional supervision, with careful monitoring of body mass, hydration, and performance. Further research with larger samples is needed to confirm its effectiveness across different athletes and sports.

Limitations and strengths

The main limitation of this study is the single-subject design, which limits generalisation of the findings. The absence of a control condition, the short intervention period, and limited dietary monitoring also restrict the interpretation of the results. In addition, the absence of weighed dietary records limits the reproducibility of the nutritional protocol. Hydration status was not assessed using urine specific gravity or other objective markers; therefore, small changes in hydration status cannot be excluded. The menstrual cycle phase was not formally controlled, which is also a limitation because body water and performance may fluctuate across the menstrual cycle in female athletes. In addition, because there was no placebo or control condition, a possible expectancy effect before a major competition cannot be excluded.

The main strength is that the study was conducted with an elite female long jumper in a real pre-competition setting. Objective jump-test data, body mass monitoring, and the athlete's personal best performance provide valuable practical evidence and justify further controlled research.

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Authors' Contribution

Conceptualization-LP, LM, SK, **Data curation**-LP, MM, **Formal analysis**-LP, SK, **Funding acquisition**-Not applicable, **Investigation**-LP, LM, MM, **Methodology**-LP, LM, SK, **Project administration**-LP, **Resources**-LP, LM, **Software**-SK, **Supervision**-LP, LM, **Validation**-LP, LM, SK, **Visualization**-LP, SK, **Writing – original draft**-LP, SK, **Writing – review & editing**-LP, LM, MM, SK. All authors read and approved the final manuscript.

Ethical Approval Information

Ethics Committee: Institute of Neurobiology, Bulgarian Academy of Sciences (registration FWA 00003059 with the US Department of Health and Human Services)

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