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Review Article

The Effects of Supplementation on the Motor Abilities of Basketball Players: A Systematic Review

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Abstract

Basketball belongs to team sports competitions that are becoming more and more intense, because it is characterized by the high physiological demands of the game itself. Explosive power, speed and agility are the motor abilities that distinguish top basketball players and are of crucial importance for success in modern basketball. Training activities of basketball players should inevitably include movement activities that will develop motor skills and improve technique. Sports supplementation is any dietary manipulation in an attempt to improve sports performance, and it has become very popular among athletes. In this regard, the aim of this study was to review the effects of supplementation on the motor abilities of basketball players. This study was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The following index databases were used to collect adequate literature: Google Scholar, PubMed and Web of Science. The analyzed papers were published in Serbian and English. 14 original scientific studies were included in the final analysis. After analyzing the results, it is concluded that there are numerous supplements that can improve the motor skills of basketball players, such as: caffeine, whey/casein proteins, drinks with electrolytes, glutamine, b-alanine, while antioxidant supplements or beetroot juice were ineffective in improving motor abilities.

Keywords: Basketball, Motor abilities, Supplements.

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Introduction

Basketball is a team sport that is becoming increasingly intense due to the game's high physiological demands (Montgomery et al, 2010). Players are getting stronger, faster, and more explosive, which makes the game more challenging (Svilar et al., 2019). Modern basketball is a complex, team-based, cyclic-acyclic sport where fundamental movements can be performed with or without the ball (Erculj et al., 2010). The game involves numerous high-intensity activities (sprints, jumps, changes of direction) that are intermittently interrupted by periods of walking and rest (Abdelkrim et al., 2007). During a 40-minute game, players cover a distance of 4000 to 5000 meters, moving in all directions while playing both offense and defense (Dako et al., 2023). Explosiveness, speed, and agility are key motor abilities that distinguish elite basketball players and are essential for success in modern basketball (Erculj et al., 2010). However, other motor abilities should not be overlooked; basketball training must include movement-based activities aimed at developing motor abilities and refining technique (Williams & Ford 2009). Training sessions should incorporate exercises to improve agility, endurance, explosive

strength, coordination, and other motor abilities that contribute to success in basketball (Santos & Janeira 2012).

The use of dietary supplements and ergogenic aids for the direct or indirect improvement of performance is becoming increasingly popular among athletes (Bishop 2001). Athletes are continuously seeking safe and effective ways to enhance their physical and mental performance, leading to increased interest in evidence-based supplementation strategies (Peeling et al., 2019). Studies by Burke et al., (2019) and Maughan et al., (2018) have shown that supplements such as caffeine, creatine, sodium bicarbonate, beta-alanine, and nitrates have positive effects on various aspects of athletic performance, including strength, endurance, and fatigue resistance. These supplements are often used in both training and competition to optimize performance outcomes (Burke et al., 2019; Maughan et al., 2018). Additionally, studies conducted on samples of male and female basketball players has provided further support for the effectiveness of dietary supplements. Specifically, the ergogenic effects of caffeine, creatine, and sodium bicarbonate have been examined in basketball contexts, with findings demonstrating a positive impact on the performance of basketball players (Abian-Vicen et al., 2014; Puente et al., 2017; Stojanović, et al., 2019). These improvements were particularly evident in activities that require high-intensity efforts, such as sprints, jumps, and rapid changes of direction — all of which are crucial in the dynamic and fast-paced nature of basketball (Stojanović, et al., 2019). Furthermore, studies have indicated that supplementation in basketball players contributes to enhancements in explosive strength and endurance, which are fundamental motor abilities in a sport that combines aerobic and anaerobic energy demands (Abian-Vicen et al., 2014; Puente et al., 2017).

Given the growing popularity of dietary supplements and ergogenic aids for improving athletic performance, as well as existing evidence supporting their positive impact on motor abilities and overall sports performance, it becomes clear that understanding their effects on basketball players is both relevant and necessary. Previous studies have highlighted the efficacy of supplements such as caffeine, creatine, sodium bicarbonate, beta-alanine, and nitrates in enhancing performance of basketball players (Abian-Vicen et al., 2014; Puente et al., 2017; Stojanović, et al., 2019). Furthermore, studies conducted specifically on basketball players has demonstrated that supplementation can improve key motor abilities like explosive power and endurance that are crucial in the aerobic-anaerobic nature of basketball (Martinez et al., 2016; Puente et al., 2017; Taylor et al., 2016). In light of this evidence, the aim of this research was to review the effects of supplementation on the motor abilities of basketball players.

Material and Methods

Literature Identification

In accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, research was identified and evaluated (Page et al., 2021). The data for this research were collected via online databases on 02.11.2024. Relevant literature was collected using the following indexing databases: Google Scholar, PubMed, and Web of Science. The search process involved the use of the following keywords: basketball, motor abilities, supplements, and effects. The PRISMA flow diagram is presented in Figure 1.

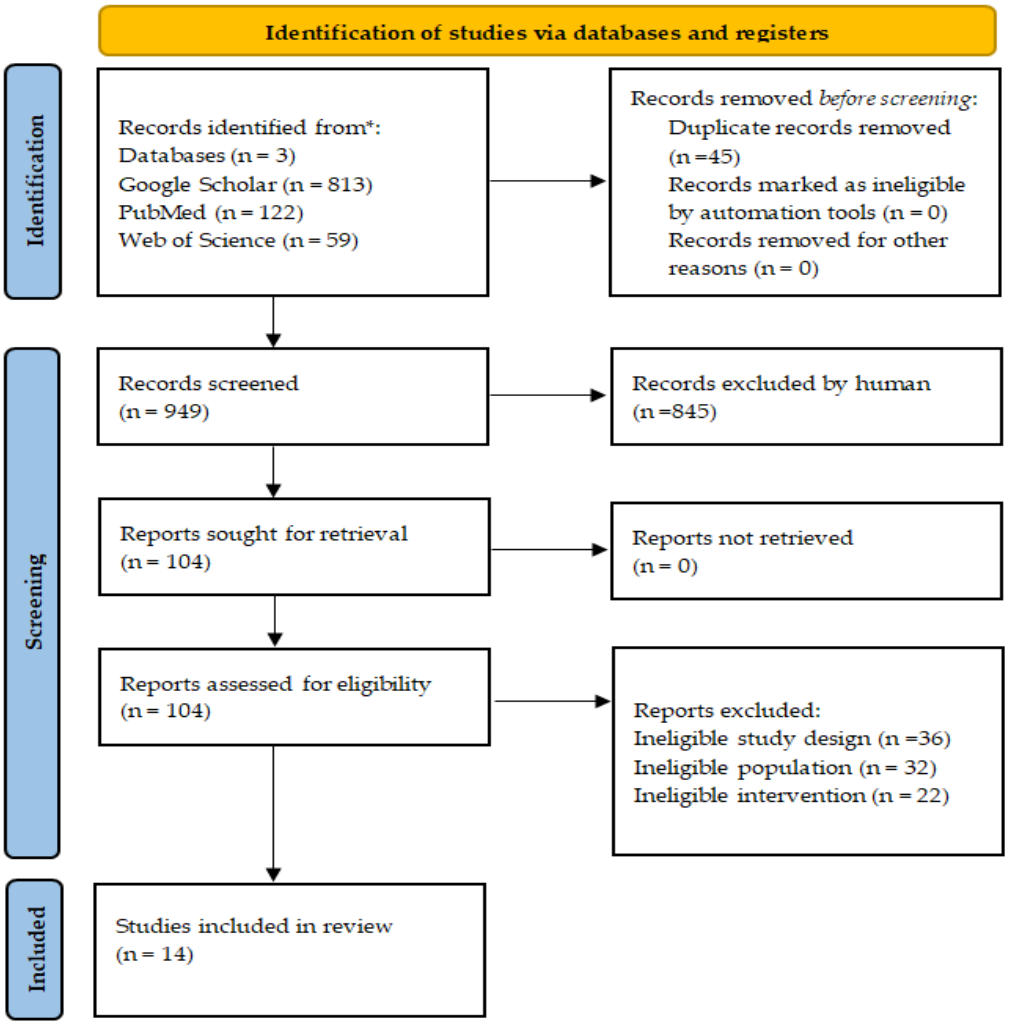

Figure 1. The PRISMA flow diagram.

Inclusion Criteria for Studies in the Analysis

The criteria for selecting studies for analysis were as follows: The studies investigated the effects of supplementation on the motor abilities of basketball players; the studies provided data on both initial and final measurements, as well as the tested parameters; the studies included information on the supplements used; and the studies were available in full text and published in Serbian or English.

Exclusion Criteria for Studies in the Analysis

Exclusion criteria for studies in the analysis were as follows: Studies of the systematic review type; studies that did not provide complete data on the supplementation program or motor abilities; studies where the full text was not available or those that were not published in Serbian or English.

Results

Table 1 presents 14 studies, including information on the first author and year of publication, the sample of participants, the supplements used, the results, and the conclusion of the studies.

Table 1. Overview of the studies.

First Author and Year of Publication	Sample of Participants	Supplements	Results	Conclusions
Dougherty et al., (2006)	M = 15 A = 12-15	5 mL of an electrolyte drink per 1 kg of BM	Improvements in precision (three-point shooting and free throw tests), while no improvements were observed in LLEP and agility	Dehydration can negatively impact precision
Tucker et al., (2013)	M = 5 A = 22 ± 6.1	Caffeine 3 mg per 1 kg of BM	There were no significant improvements in LLEP or in VO_{2max}	Caffeine did not lead to improvements in MA
Wilborn et al., (2013)	F = 16 A = 20.0 ± 1.9	24 g x2 whey (1) 24 g x2 casein (2) Daily, before and after training, for 8 weeks	Significant improvements were observed in the final measurement for LLEP (CMJ and VS)	These supplements had impact on MA
Abian-Vicen et al., (2014)	M = 16 A = 14.9 ± 0.8	Caffeine 3 mg per 1 kg of BM	Improvements were observed in LLEP (CMJ and maximum jumps in 15 seconds)	Caffeine acutely improved LLEP but not precision
Kaldirimci et al., (2015)	M = 40 A = 20.4 ± 1.6	Glutamine (2 g with 500 ml of water)	Significant improvements were recorded on precision and MRS	Glutamine positively impacted precision and MRS
Taylor et al., (2016)	F = 8 A = 20 ± 2	24 g of whey protein immediately after training for 8 weeks	Significant improvements were observed in LLEP (VJ), ULS (1RM bench press), and agility (T-test)	Whey positively impacted body composition and MA
Martinez et al., (2016)	M = 13 A = 24 ± 6	Caffeine 3 mg per 1 kg of BM	Significant improvements in anaerobic endurance were observed	Caffeine before activity improves anaerobic endurance
Milioni et al., (2017)	M = 17 A = 17 ± 1.0	6.4 g of b-alanine daily for 6 weeks	Significant improvements in endurance (Yo-Yo test) were observed	B-alanine improved only cardiovascular endurance
Puente et al., (2017)	M = 10 F = 10 A = 27.1 ± 4.0	Caffeine 3 mg per 1 kg of BM	Improvements were observed in LLEP (Abalakov jump test)	Caffeine is effective in improving LLEP

Baralic et al., (2019)	F = 14 A = 20.6 ± 2.7	Antioxidant GE132	No statistically significant changes were observed in MA	This supplement benefited muscle recovery
López-Samanes et al., (2020)	M = 10 A = 15-16	Beetroot juice (140 mL)	No significant improvements in MA were observed	Beetroot juice did not improve basketball players' MA
Scanlan et al., (2019)	M = 11 F = 10 A = 18.3 ± 3.3	Caffeine 3 mg per 1 kg of BM	No significant improvements in MA were observed	Caffeine did not improve the tested parameters
Tan et al., (2020)	M = 12 F = 6 A = 23.1 ± 1.9	Caffeine 6 mg per 1 kg of BM	No significant improvements in MA were observed	Caffeine did not improve the tested parameters
Stojanović et al., (2021)	M = 11 A = 16.5 ± 1.0	Caffeine 3 mg per 1 kg of BM	Significant improvements were observed in speed (sprint test), LLEP (VJ, CMJ, CMJarm), and agility (change-of-direction test)	Caffeine had significant morning effects, not evening

1RM: one maximum repetition; A: age; BM: body mass; CMJ: countermovement jump; CMJarm: countermovement jump with arm swing; F: female; LLEP: lower limbs explosive power; M: male; MRS: motor reaction speed; ULS: upper limbs strength; VJ: vertical jump; MA: motor abilities.

All 14 studies had the same aim, which was to examine the effects of supplementation on the motor abilities of basketball players. For this reason, the objective of the studies is not presented in Table 1. Upon reviewing the studies listed in Table 1, it can be concluded that the number of participants did not vary significantly from one study to another. The smallest sample size of 5 participants was in the study by Tucker et al., (2013), while the largest sample size of 40 participants was in the study by Kaldirimci et al., (2015). The total number of participants included in this systematic review was 224, with 160 male basketball players and 64 female basketball players. When considering the age characteristics of the participants, it can be observed that the studies included participants of various ages, ranging from 12 to 15 years old. The study by Dougherty et al., (2006) had participants aged 12 to 15 years, which was the youngest sample among the studies reviewed.

The majority of the studies presented in Table 1 focused on examining the effects of caffeine supplementation on the motor abilities of basketball players (Abian-Vicen et al., 2014; Martinez et al., 2016; Puente et al., 2017; Scanlan et al., 2019; Stojanović et al., 2021; Tan et al., 2020; Tucker et al., 2013). There were also studies that investigated the effects of protein supplementation (Whey or Casein) (Taylor et al., 2016; Wilborn et al., 2013), beta-alanine (Milioni et al., 2017), Glutamine (Kaldirimci et al., 2015), electrolyte drinks (Dougherty et al., 2006), antioxidants GE132 (Baralic et al., 2019), and beetroot juice (López-Samanes et al., 2020) on the motor abilities of basketball players.

Discussion

The aim of this study was to review the effects of supplementation on the motor abilities of basketball players. Sports supplementation refers to any dietary intervention aimed at enhancing athletic performance (Maughan et al., 2018). Previous studies (Abian-Vicen et al., 2014; Puente et al., 2017) have shown that supplementation in basketball players contributed to improvements in explosive power and endurance — abilities that can play a critical role in this aerobic-anaerobic sport. Given the evidence of the positive impact of supplements on motor abilities and overall athletic performance, the aim of this systematic review was to examine the effects of supplementation on the motor abilities of basketball players.

Analyzing the data presented in Table 1, it is evident that most studies focused on the effects of caffeine on the motor abilities of basketball players (Abian-Vicen et al., 2014; Martinez et al., 2016; Puente et al., 2017; Scanlan et al., 2019; Stojanović et al., 2021; Tan et al., 2020; Tucker et al., 2013). The earliest study on caffeine effects (Tucker et al., 2013) did not observe statistically significant improvements in lower limb explosive power (LLEP) with a dose of 3 mg of caffeine per 1 kg of body mass. In contrast, Abian-Vicen et al., (2014) found that the same dose improved LLEP in the squat jump and 15-second maximum jump test, although it did not enhance free-throw accuracy. Martinez et al., (2016) reported improvements in endurance but found no changes in LLEP, upper limb explosive power (ULEP), or overall motor abilities. Similarly, Puente et al., (2017) observed improvements in LLEP (measured by the Abalakov jump test) in both male and female basketball players but found no positive effects on precision or agility. Their findings suggest that caffeine can induce acute improvements in LLEP if taken 60 minutes before activity. Scanlan et al., (2019) noted no significant changes in coordination or dribbling speed after supplementation with 3 mg of caffeine per kg of body mass. Tan et al., (2020) also reported no improvements in shooting precision. However, Stojanović et al., (2021) observed significant improvements in speed (sprint test), LLEP (vertical jump and squat jump with preparation), and agility (change-of-direction test). Notably, they found that caffeine consumption in the morning was more effective than in the evening for enhancing motor abilities. Finally, Lazić et al., (2022) explored the effects of 3 mg and 6 mg of caffeine per kg of body mass on basketball performance. Their results indicated improvements in multiple motor ability variables, especially LLEP, speed, and agility. However, none of the studies reported improvements in precision, and no gender-related differences were identified in the effects of caffeine on motor abilities.

Furthermore, studies investigating protein intake (Taylor et al., 2016; Wilborn et al., 2013) reported the following findings: The study by Wilborn et al., (2013) examined the effects of protein supplementation with 24 g of whey protein twice daily and 24 g of casein twice daily (consumed before and after training) over an 8-week period. Analysis of test results showed that protein supplementation led to improvements in LLEP, measured through the 1RM leg press, and in LLEP, assessed through the squat jump with preparation and the vertical jump tests. Although these improvements in motor abilities were observed, further analysis revealed that protein supplementation had a more significant impact on body composition. The study by Taylor et al., (2016) demonstrated that daily supplementation with 24 g of whey protein had positive effects on LLEP, ULEP and agility. These studies focused on the effects of protein supplementation on the motor abilities of female basketball players, indicating that the results are applicable specifically to the female population.

Mahmoud et al., (2024) emphasizes precision as the most important motor ability for successful basketball performance. Supporting this, the study by Dougherty et al., (2006) demonstrated improved precision following supplementation with an electrolyte drink designed for rehydration. Additionally, Kaldirimci et al., (2015) investigated the effects of glutamine supplementation (2 g with 500 ml of water) on motor abilities. While no positive effects on LLEP were observed, the authors reported improvements in precision and speed. Milioni et al., (2017) examined the effects of β-alanine supplementation (6.4 g per day for 6 weeks) on motor abilities. Their results showed that this supplement enhanced endurance (Yo-Yo test) but did not improve precision (free-throw test) or LLEP (countermovement jump - CMJ). Baralic et al., (2019) investigated the effects of GE132 antioxidant supplementation on the strength of female basketball players. The authors did not observe significant effects on LLEP, grip strength, or repetitive strength. However, they did note a significantly shorter muscle recovery time after intense activities. Similarly, López-Samanes et al., (2020) examined the effects of beetroot juice (140 mL) on LLEP, speed, and agility. The authors concluded that supplementation with beetroot juice before a match did not result in improvements in the tested variables, which aligns with findings from previous literature (Cuenca et al., 2018).

This study has several limitations. Conducting the literature review exclusively in English and Serbian is a significant limitation of this research. Furthermore, restricting the review to only Google Scholar, PubMed, and Web of Science databases limited the comprehensiveness of the accessed literature.

For future research, it is recommended to conduct literature reviews in a broader range of languages, such as Turkish or other languages, which may allow the inclusion of diverse cultural and regional studies. Additionally, incorporating other academic databases, such as Scopus or EBSCOhost, could facilitate access to more comprehensive and diversified data. This approach would enhance the generalizability and reliability of the research findings.

Conclusions

Sports supplementation is an addition to the diet aimed at improving athletic performance. Basketball is a sport where success is reflected not only in technical-tactical skills but also in motor abilities. In this regard, this systematic review examined the effects of various supplements on the motor abilities of basketball players. After analyzing the results, it was concluded that there are several supplements that can improve the motor abilities of basketball players, such as caffeine, whey/casein proteins, electrolyte drinks, glutamine, and beta-alanine. On the other hand, antioxidant supplements or beetroot juice were ineffective in improving motor abilities. Finally, it is important to note that necessary nutrients should primarily be obtained through food, as supplements cannot replace meals.

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Conflict of Interest: The authors declare no conflicts of interest regarding this study.

Data Availability Statement: Data supporting this study is available from the authors upon reasonable request.

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