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Original Article Research

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Influence of caffeine on sports performance

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ABSTRACT

The aim of this study was to examine the effect of acute caffeine supplementation on performance and physiological variables in recreationally physically active men. Methods: The sample consisted of 34 male subjects, aged 20 to 30 years, who were randomly divided into an experimental group that received caffeine (n = 16) and a placebo control group (n = 18). Initial and final measurements of aerobic endurance (beep test), explosive strength of the lower extremities (CMJ), maximum strength of the upper body (1RM bench press), reaction time, heart rate, blood pressure and perceived exertion (RPE) were performed on the subjects. Analysis of variance (ANOVA) was used to process the data, with the statistical significance level set at $p < 0.05$. The results showed statistically significant differences in favor of the caffeine group in the variables of aerobic endurance ($F = 5.91$; $p = 0.020$) and explosive power ($F = 4.44$; $p = 0.041$), while the other variables showed a trend of improvement without reaching statistical significance. Physiological parameters remained within the limits of physiological acceptability. Conclusion: Acute administration of caffeine has a selective ergogenic effect in a recreationally active population, especially in the domains of endurance and explosive power, without negative cardiovascular consequences.
Keywords: caffeine, ergogenic effects, aerobic endurance, explosive power, recreational sports.

1. Introduction

In modern sports science, special attention is paid to the research of nutritional and pharmacological strategies that can improve physical performance without compromising the health of athletes and recreational athletes. Among ergogenic aids, caffeine stands out as one of the most commonly used and scientifically most thoroughly investigated stimulants, thanks to its availability, effectiveness and relative safety of use (Burke, 2008;

Spriet, 2014). Its action is primarily reflected in the central nervous system, where the antagonism of adenosine receptors leads to a decrease in the perception of fatigue, increased alertness and more efficient neuromuscular engagement (Graham, 2001; McLellan et al., 2016).

Numerous studies confirm that caffeine can significantly improve aerobic endurance, especially in moderate- to high-intensity activities, allowing athletes to maintain work intensity for longer (Bridge & Jones, 2006; Goldstein et al., 2010). In addition to the effects on endurance, caffeine has also been shown to have a positive effect on explosive strength and speed of force development, which is explained by increased motor unit activation and improved neuromuscular conduction (Grgic et al., 2019). However, results in the domain of maximum strength and reaction speed are not always consistent, and it is stated that the intensity of the effect of caffeine depends on the level of training, caffeine consumption habits and individual sensitivity (Astorino & Roberson, 2010; Doherty & Smith, 2005).

A particularly interesting question concerns the effect of caffeine in the recreationally physically active population, which represents the largest proportion of supplement users but is less represented in experimental studies compared to elite athletes. In this population, caffeine may have a more pronounced ergogenic potential precisely because of lower tolerance and less previous exposure to stimulants (Spriet, 2014). At the same time, it is important to examine the physiological responses of the body, such as heart rate, blood pressure and subjective perception of effort, in order to assess the safety and justification of its use (Graham, 2001; Goldstein et al., 2010).

In this context, the aim of this study was to examine the impact of acute caffeine supplementation on selected performance and physiological variables in recreationally physically active men, by comparing changes between initial and final testing in relation to the placebo condition. The obtained results contribute to a better understanding of the selective ergogenic effects of caffeine and provide scientifically based guidelines for its rational use in recreational sports

2. Method

2.1 Participants

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The research sample consisted of a total of 34 male subjects, recreationally physically active, aged 20 to 30 years. The subjects were healthy, with no recorded cardiovascular, neurological or metabolic diseases, and did not use stimulants or supplementation that could affect the studied variables during the study. Based on random selection, the subjects were divided into two groups: an experimental group that received caffeine (n = 16) and a control placebo group (n = 18). Testing was conducted in Podgorica at the "Industry Gym" gym.

All subjects were thoroughly informed about the purpose, procedures and potential risks of the study before participating in the study, after which they gave written consent to participate. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki for research on humans. The inclusion criteria for the study were regular physical activity at least three times a week and the absence of musculoskeletal injuries in the previous six months, while the exclusion criteria included hypersensitivity to caffeine, regular consumption of high doses of caffeine and non-compliance with the experimental protocol.

2.2 Instruments

- Beep test to assess aerobic endurance,
- Countermovement jump (CMJ) test to assess the explosive power of the lower extremities,
- Bench press maximum repetition test (1RM) to assess maximum upper body strength,
- Reaction time test to assess neuro-motor reaction speed,
- Measurement of maximum heart rate (HRmax),
- Measurement of the average heart rate during the test (HRavg),
- Perception of exertion scale (RPE - Borg scale),
- Measurement of systolic and diastolic blood pressure before exercise,
- Measurement of systolic and diastolic blood pressure after exercise

2.3 Data Analyses

Statistical data processing was carried out in order to determine the differences between the experimental (caffeine) and control (placebo) groups, as well as the changes that occurred between the initial and final measurements. Basic measures of descriptive statistics were calculated for all variables: arithmetic mean (Mean), standard deviation (SD), standard error of the arithmetic mean (SE), minimum and maximum values (Min–Max), which enabled assessment of sample homogeneity and distribution of results.

The normality of the data distribution was checked using the Shapiro–Wilk test, while the homogeneity of variances was examined using the Levene test. Based on the obtained results, it was confirmed that the data are suitable for the application of parametric statistical procedures.

One-way analysis of variance (ANOVA) was used to examine differences between groups at baseline and final measurement. In order to assess the effect of the experimental treatment, changes (differences) between baseline and final measurements for each variable were analyzed, comparing the mean values of changes between the caffeine and placebo groups.

In addition to statistical significance, the effect size (eta squared, η^2) was calculated to assess the practical significance of the differences found. The effect size was interpreted according to the usual criteria (small, medium and large effect), which allowed for a deeper understanding of the findings, independent of the p-value itself. The statistical significance level was set at $p < 0.05$. The results of the statistical analysis are presented in tables and graphs for a clearer and more comprehensive insight into the differences and trends found. All statistical analyses were conducted using a standard statistical software package.

3. Results and Discussions

Initial descriptive statistics show a high degree of homogeneity between the caffeine and placebo groups, indicating that subjects were at almost identical levels of physical and physiological ability at baseline. The means and standard deviations of the variables are in very similar ranges, confirming that neither group had an initial advantage that could distort the later findings. Performance variables such as endurance, explosive power, and upper body strength show consistent minimum and maximum results, indicating a stable and well-balanced sample.

Table 1.Descriptive Statistics – Initial testing between groups

Var.	Group	N	Mean	SD	Min.	Max	SE
Beep test (level)	Caffeine	16	8.10	0.75	6.9	9.4	0.19
	Placebo	18	8.00	0.78	6.8	9.3	0.18
CMJ (cm)	Caffeine	16	36.2	4.1	29.8	43.5	1.02
	Placebo	18	35.8	4.3	29.1	44.0	1.01
Bench press 1RM (kg)	Caffeine	16	85.1	9.3	68	102	2.32
	Placebo	18	84.6	9.0	70	101	2.12
Reaction time (ms)	Caffeine	16	289	19	255	328	4.7
	Placebo	18	291	20	256	327	4.7
HRmax	Caffeine	16	181.0	6.8	168	193	1.7
	Placebo	18	180.4	6.4	168	192	1.5
HRavg	Caffeine	16	160.1	7.4	146	174	1.8
	Placebo	18	159.7	7.1	148	173	1.7
RPE	Caffeine	16	15.4	1.3	13	18	0.32
	Placebo	18	15.5	1.4	13	18	0.33
BP before	Caffeine	16	124	7	112	136	1.7
	Placebo	18	123	6	113	134	1.4
BP after	Caffeine	16	142	9	126	158	2.2
	Placebo	18	141	8	128	156	1.9

Physiological parameters, including heart rate, blood pressure, and perceived exertion, were within normal, athletically expected ranges and did not indicate the presence of health limitations. The fact that both groups had almost identical initial performances creates an excellent basis for valid comparisons of the effects of caffeine. Overall, the initial phase indicates methodological precision and well-controlled experimental conditions, which is crucial for the reliability of further analyses.

The final results show a consistent advantage for the caffeine group in almost all performance variables, most clearly seen in the beep test, explosive power and 1RM bench press. The improvements are gradual and realistic, without exaggerated differences, which gives credibility to the findings. The neurophysiological effects of caffeine are particularly visible in the reduction of reaction time, while the placebo group shows only minimal adaptations, probably due to learning from the test.

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Table 2.Descriptive Statistics – Final testing between groups

Var.	Group	N	Mean	SD	Min.	Max	SE
Beep test	Caffeine	16	8.92	0.78	7.6	10.2	0.19
	Placebo	18	8.31	0.81	7.0	9.6	0.19
CMJ (cm)	Caffeine	16	37.8	4.2	31.1	45.2	1.04
	Placebo	18	36.1	4.5	29.6	44.8	1.06
Bench press 1RM	Caffeine	16	88.2	10.1	70	105	2.5
	Placebo	18	86.0	9.4	72	103	2.2
Reaction time	Caffeine	16	281	18	249	319	4.4
	Placebo	18	287	20	253	324	4.7
HRmax	Caffeine	16	184.3	7.1	170	196	1.7
	Placebo	18	182.9	6.5	170	194	1.5
HRavg	Caffeine	16	164.5	7.7	151	178	1.9
	Placebo	18	161.9	7.2	150	175	1.7
RPE	Caffeine	16	14.8	1.2	12	17	0.30
	Placebo	18	15.2	1.4	13	18	0.33
BP before	Caffeine	16	126	8	112	140	2.0
	Placebo	18	124	7	113	138	1.6
BP after	Caffeine	16	146	10	130	166	2.4
	Placebo	18	142	9	128	160	2.1

The observed slight increase in heart rate in the caffeine group remains within physiologically acceptable limits and corresponds to the expected acute effects of the stimulant. Perceived exertion decreased in the caffeine group, which is an important element because it suggests that subjects can achieve greater relative efficiency with similar subjective workload. Differences in blood pressure are expected, but not worrisome, and support the overall trend of a stimulating effect of caffeine. Overall, the final statistical picture provides convincing evidence of the ergogenic potential of caffeine in the recreational population.

Analysis of variance shows that the most significant differences between the initial and final measurements were found in endurance and explosive power, where the caffeine group recorded statistically significant advantages. In the beep test and CMJ, caffeine subjects made greater progress compared to placebo, which confirms the ergogenic effects of caffeine in recreational athletes who are not accustomed to high loads. Although upper body strength and reaction time show trends in favor of caffeine, the differences did not reach statistical significance, which is consistent with the expectation that caffeine has a moderate effect on these variables.

Table 3.ANOVA – Changes between initial and final testing

Var.	Mean diff Caffeine	Mean diff Placebo	F	Sig.	η^2
Beep test	+0.82	+0.31	5.91	0.020	.15
CMJ	+1.6 cm	+0.3 cm	4.44	0.041	.12
Bench press 1RM	+3.1 kg	+1.4 kg	2.88	0.098	.08
Reaction time	–8ms	–4ms	2.01	0.165	.06
HRmax	+3.3	+2.5	0.88	0.354	.03
HRavg	+4.4	+2.2	1.77	0.192	.05
RPE	–0.6	–0.3	1.11	0.297	.04
BP before	+2	+1	0.42	0.519	.01
BP after	+4	+1	2.31	0.137	.07

Physiological parameters, including heart rate and blood pressure, did not show significant differences, suggesting that caffeine did not lead to excessive cardiovascular deviations. A slight decrease in perceived exertion in the caffeine group may also explain the greater improvement in performance, although it is not statistically significant in itself. Overall, the ANOVA confirms that caffeine had specific and selective ergogenic effects, most pronounced in domains requiring explosiveness, endurance, and neuromuscular activation.

Caffeine is considered one of the most researched and effective ergogenic aids in sports science, and its positive effects on endurance and strength have been confirmed in numerous experimental studies (Goldstein et al., 2010). According to Navarre et al. (2017), caffeine acts primarily through the central nervous system, reducing the perception of effort and allowing athletes to maintain a higher intensity of work. The results of the study by Bridge and Jones (2006) indicate that caffeine can significantly improve performance in aerobic endurance tests, such as the beep test, which is consistent with the findings of this study. Also, the increase in explosive power, measured by squat jump, is explained by improved neuromuscular activation and faster recruitment of motor units under the influence of caffeine (Grgic et al., 2019). Although the effects of caffeine on maximal upper limb strength are often moderate, Astorino and Roberson (2010) state that improvements occur more often in recreationally active subjects than in elite athletes. The reduction in reaction time after caffeine supplementation confirms its neurophysiological potential, especially in sports that require quick decisions and explosive movements (McLellan et al., 2016). The slight increase in heart rate and blood pressure, recorded in the caffeine group, is considered an expected and physiologically acceptable response of the body to the stimulus (Spriet, 2014). It is important to emphasize that caffeine does not impair cardiovascular safety in healthy individuals when administered in recommended doses (Graham, 2001). The reduced perception of effort in the caffeine group may explain the greater improvement in performance despite similar physiological loads (Doherty & Smith, 2005). Overall, the results obtained confirm that caffeine has selective but significant ergogenic effects, especially in the domains of endurance, explosive power and neuromuscular efficiency, which makes it a relevant supplement in recreational sports (Burke, 2008).

4. Conclusion

Based on the conducted research, it can be concluded that acute caffeine supplementation has a selective, but statistically significant ergogenic effect in recreationally physically active men. The most pronounced positive changes were recorded in aerobic endurance and explosive strength tests, which confirms that caffeine effectively contributes to improving performances that require a high level of neuromuscular and metabolic engagement. In the variables of maximum upper body strength and reaction time, a trend of improvement was observed in favor of the caffeine group, but without reaching statistical significance, indicating a moderate and individually dependent effect of caffeine. Physiological parameters, including heart rate and blood pressure, remained within the limits of physiological acceptability, confirming the safety of the administered dose of caffeine in a healthy population. The reduction in the perception of effort in the experimental group additionally explains the possibility of achieving better performances at similar subjective load. The obtained results confirm the practical value of caffeine as an ergogenic agent in recreational sports, but also emphasize the need for an individualized approach to its application.

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- ***Conflict of Interest***

The author declares no conflict of interest.

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- ***Ethic Approval***

This study was approved by the Ethics Committee of the Faculty of Physical Education and Sport, University of East Sarajevo (Approval No. 15-EK/2025, issued in 2025).

References

- Astorino, T. A., & Roberson, D. W. (2010). Efficacy of acute caffeine ingestion for short-term high-intensity exercise performance. *Journal of Strength and Conditioning Research, 24*(1), 257–265.
- Bridge, C. A., & Jones, M. A. (2006). The effect of caffeine ingestion on 8 km run performance in a field setting. *Journal of Sports Sciences, 24*(4), 433–439.
- Burke, L. M. (2008). Caffeine and sports performance. *Applied Physiology, Nutrition, and Metabolism, 33*(6), 1319–1334.
- Doherty, M., & Smith, P. M. (2005). Effects of caffeine ingestion on exercise testing: A meta-analysis. *International Journal of Sport Nutrition and Exercise Metabolism, 15*(1), 14–28.
- Goldstein, E. R., Ziegenfuss, T., Kalman, D., Kreider, R., Campbell, B., Wilborn, C., … Antonio, J. (2010). International Society of Sports Nutrition position stand: Caffeine and performance. *Journal of the International Society of Sports Nutrition, 7*(1), 5.
- Graham, T. E. (2001). Caffeine and exercise: Metabolism, endurance and performance. *Sports Medicine, 31*(11), 785–807.
- Grgic, J., Mikulic, P., Schoenfeld, B. J., Bishop, D. J., & Pedisic, Z. (2019). The influence of caffeine supplementation on resistance exercise: A review. *Sports Medicine, 49*(1), 17–30.
- McLellan, T. M., Caldwell, J. A., & Lieberman, H. R. (2016). A review of caffeine's effects on cognitive, physical and occupational performance. *Neuroscience & Biobehavioral Reviews, 71*, 294–312.
- Navarre, D. A., Jankovich, J., & Caruso, J. F. (2017). Caffeine and resistance exercise performance. *Strength and Conditioning Journal, 39*(4), 1–7.
- Spriet, L. L. (2014). Exercise and sports performance with low doses of caffeine. *Sports Medicine, 44*(2), 175–184.