JSSF (11) (1) (2025)

Journal of Sport Sciences and Fitness

https://journal.unnes.ac.id/journals/jssf

Caffeine as an Ergogenic Aid: Enhancing Power Output in Wrestlers

Syafira Salsabila*, Syifa F. Syihab, Muchamad Rizki Sentani, Fajria Saliha Puspita Prameswari

Nutrition Study Program, Faculty of Sports and Health Education, Universitas Pendidikan Indonesia

Article's Info

Article's History:
Submitted June 19, 2025
Revised August 20, 2025
Accepted August 25, 2025

Keywords:
caffeine, power, wrestling athletes, ergogenic aid, sports performance

DOI:
https://doi.org/10.15294/dc3edq29

Abstract

Introduction: Caffeine is known as an ergogenic aid that can enhance sports performance by stimulating the central nervous system and reducing perceived fatigue. **Objectives:** This study aims to determine the effect of caffeine consumption on increasing upper body power in wrestling athletes. **Method:** This research employed an experimental design with a pre-test and post-test approach on two groups: an intervention group (n=13) that consumed caffeine at a dose of 3–6 mg/kgBW and a control group (n=13) that consumed a placebo. Upper body power was measured using the chest medicine ball throw test, and the data were analyzed using paired t-tests to examine within-group differences and independent t-tests to compare between groups. **Result:** Paired t-test results showed a significant increase in power within both groups ($p<0.05$). However, independent t-test results indicated a statistically significant difference between the intervention and control groups ($p = 0,002$; $p < 0,05$), with the intervention group showing a greater increase in power. **Conclusion:** These findings suggest that caffeine consumption positively impacts the power performance of wrestling athletes. Based on this study, it is suggested that strategic caffeine supplementation may serve as a more effective approach in supporting overall athletic performance.

*Correspondence E-mail:
syafirasalsabila@upi.edu

PISSN 2252-6528
EISSN 2745-5718

INTRODUCTION

Power is an essential factor in wrestling performance (Alifiansyah, 2024; Mota & Marocolo, 2022; Wilborn et al., 2018). Due to the mix of strength, quickness, and high endurance required for wrestling, athletes are increasingly turning to caffeine before training or competition (Caramoci et al., 2016). Suboptimal power output may result in decreased peak force during rapid movements, thereby undermining the effectiveness of techniques like slams and takedowns, which may become less powerful or slower (Caramoci et al., 2016; Davidson et al., 2022; Eroğlu, 2022). Lack of power can also impact lactate metabolism, which can lead to a worse level of physical and mental health and an earlier onset of tiredness during competition (Jurov et al., 2021, 2022). Consequently, various efforts are undertaken to optimize power during training and competition, including ergogenic nutritional interventions such as caffeine consumption. Caffeine enhances athletic performance, especially in activities that demand strength and speed.

Power enhancement can be achieved via specialized training, appropriate nutrition, sufficient recovery, and the application of ergogenic aids, including caffeine (Bonilla et al., 2023; Hernández et al., 2017; Irandoust, 2023; Rachma et al., 2024). Caffeine functions by inhibiting adenosine receptors, which diminishes perceived fatigue and enhances alertness (Scapec et al., 2024; Szerej et al., 2024). Research indicates enhancements in muscular strength, anaerobic power, and both aerobic and muscular endurance (Baltazar-Martins et al., 2019). The optimal caffeine dosage for power-enhancing effects is between 3 and 3–6 mg/kg (Grgic et al., 2020). There are, however, still few research explicitly examining caffeine's effects on power in wrestling, especially in athlete populations, despite the drug's well-established advantages in a variety of sports.

Given that explosive techniques such as takedowns, throws, and slams heavily rely on power, maintaining and enhancing power is urgent for wrestling performance (Alifiansyah, 2024). Although caffeine has been widely studied in relation to endurance and general strength, few studies have directly investigated its effect on wrestlers' power output (Grgic et al., 2020). Most prior findings are either limited to endurance sports or other combat disciplines, leaving a clear research gap (Grgic et al., 2020).. This study therefore provides novel evidence by examining the acute effects of caffeine supplementation on upper-body power in wrestlers, a population and performance outcome that remain underexplored.

Preliminary observations of wrestlers from the Scorpion Wrestling Club and the UPI Wrestling Student Activity Unit (UKM Gulat UPI) in Bandung indicate a trend of improving athletic performance over time. Both clubs have attained medals in multiple competitions at the regional, provincial, and national levels. This indicates that an athlete's potential can be enhanced by continuous training and the implementation of evidence-based performance strategies. Caffeine consumption patterns among wrestlers in these two clubs indicate that 76.5% of athletes utilize caffeine, predominantly from coffee and supplements.

According to these studies, wrestlers from both clubs exhibit considerable performance potential and have been utilizing performance-enhancing strategy via caffeine usage. The impact of caffeine on power, particularly in wrestling, has not been thoroughly investigated (Negaresh et al., 2018). Despite significant potential for advancement, there is a deficiency of scientific methodologies explicitly aimed at enhancing athlete performance inside these clubs. This study seeks to fill the information vacuum by investigating the impact of caffeine on power improvement in wrestlers in Bandung, utilizing case studies from the Scorpion Wrestling Club and the UPI Wrestling Student Activity Unit. In particular, the study examines whether supplementing with caffeine before and after use affects wrestlers' power and whether power changes between caffeine-consuming wrestlers and those in the control group differ significantly.

METHOD

The design employed in this study is experimental, utilizing a controlled group approach with pretest and post-test measurements. The respondents consisted of 26 wrestlers from two clubs in Bandung City, namely the Scorpion Wrestling Club and the UPI Wrestling Student Activity Unit (UKM Gulat UPI). Participants were selected using purposive sampling. These wrestlers were randomly assigned into two groups: the intervention group (n=13), which received caffeine supplementation at a dose of 3–6 mg/kg body weight, and the control group (n=13), which received placebo capsules. The intervention consisted of a single acute supplementation session. Wrestlers in the intervention group received caffeine capsules at a dose of 3–6 mg/kg body weight, while the control group received identical placebo capsules. The supplementation was administered once, 30 minutes before the post-test measurement, following the pre-test conducted under normal conditions without supplementation. Thus, each participant underwent two testing sessions: (1) a baseline pre-test without supplementation and (2) a post-test following supplementation or placebo ingestion. Upper body muscular power was assessed using the chest medicine ball throw test, conducted before and after the intervention. Data analysis involved paired t-tests to examine changes within each group, as well as independent t-tests and Mann-Whitney U tests to compare differences between the two groups. This study has received ethical approval from the Research Ethics Committee of Universitas Negeri Malang.

Before the intervention, baseline profiles of respondents were assessed to ensure equivalence between the intervention and control groups. Key characteristics included demographic and physiological variables such as age, training frequency, caffeine consumption habits, anthropometric measurements, and cardiovascular indicators. Establishing similarity in baseline characteristics was critical for retaining internal validity, ensuring that any differences in outcomes could be attributed to caffeine’s effects rather than

pre-existing disparities. Table 1 summarizes the main characteristics of the respondents in each group.

Table 1. Characteristics of the Respondents

Variable	Intervention Group (n=13)	Control Group (n=13)	P
Age (Mean ± SD)	19.92 ± 2.02	20.31±2.25	0.753
Training Frequency ≥3x/week (%)	92.3%	76.9%	0.286
Caffeine Consumption (Rare, %)	53.8%	53.8%	1.000
Body Weight (kg), Mean ± SD	70.24±14.01	76.17± 17.57	0.521
Body Mass Index (kg/m²), Mean ± SD	24.62 ± 4.18	25.84 ± 4.47	0.478
Systolic Blood Pressure (mmHg), Mean ± SD	114 ± 5.87	112.31± 6.92	0.508
Heart Rate (beats/min), Mean ± SD	81.31±15.94	77.77± 13.17	0.543

Analysis showed no significant differences between groups in age, training frequency, caffeine consumption habits, body weight, BMI, systolic blood pressure, or heart rate ($p > 0.05$). Most respondents in both groups reported a high training frequency (≥3 times per week) and were classified as infrequent caffeine consumers. This homogeneity at baseline supports the objective assessment of caffeine's effect on power enhancement.

RESULT AND DISCUSSION

Result

Referring to Table 2, the mean power values in the intervention group receiving caffeine were higher compared to the control group receiving placebo, both at pretest and post-test. In the intervention group, the mean pretest power levels were 4.646 ± 0.209 meters, with a range of 3.1 meters to 5.8 meters. In the intervention group, post-test power varied from 4.0 to 6.2 meters, with an average of 5.323 ± 0.1899 meters. On the other hand, the pretest power values for the control group had a mean of 4.508 ± 0.1053 meters and varied from a minimum of 3.8 meters to a maximum of 5.0 meters. The post-test power in the control group was 4.731 ± 0.0963 meters, with a range of 4.3 to 5.5 meters.

Table 2. Characteristics of the Respondents

Group	Test	Min	Max	Mean	SD
Intervention (n=13)	Pre	3.1	5.8	4.646	0.2090
	Post	4	6.2	5.323	0.1899
Control (n=13)	Pre	3.8	5	4.508	0.1053
	Post	4.3	5.5	4.731	0.0963

Effect of the Caffeine Group on Power Improvement

The change in outcome was evaluated using a paired t-test to determine the significance of the differences observed post-intervention. Table 3 displays the mean values, standard deviations, and correlation results between the pre-test and post-test.

Table 3. Results of Power Test Within Groups (Paired T-Test)

Group	*Mean Pre ± SD*	*Mean Post ± SD*	*Mean Difference ± SD*	*t*	*P*
Intervention	4.65 ± 0.75	5.32 ± 0.68	0.6769 ± 0.4381	5.57	0.000
Control	4.51 ± 0.38	4.73 ± 0.35	0.2231 ± 0.1964	4.09	0.001

Based on the results of the paired t-test, both groups experienced significant changes in power; however, the intervention group demonstrated a greater increase compared to the control group. The control group showed a mean difference of 0.2231 ± 0.1964 with a t-value of 4.094 and p = 0.001, indicating a significant difference before and after the intervention. Meanwhile, the intervention group exhibited a larger increase, with a mean difference of 0.6769 ± 0.4381, a t-value of 5.571, and p = 0.000, also indicating a significant difference.

Comparison of Power Improvement Between the Caffeine and Placebo Groups

The next step in the data analysis was to conduct a difference test to determine whether there was a significant improvement in power between the intervention group consuming caffeine and the control group not consuming caffeine. This analysis employed an independent t-test, examining the mean difference and p-value. The results of the difference test for power improvement between the intervention and control groups are presented in Table 4.

Table 4. Results of Power Test Between Groups (Independent t-Test)

Variable	Group		Mean Diffe-rence	P-value (2-tailed)
	Intervention	Control		
ΔPower	0.677 ± 0.44	0.223 ± 0.19	0.454	0.002

The results of the independent t-test demonstrate a significant difference in the power of wrestlers between the group that received caffeine supplementation and the control group that received a placebo. The power increase observed in the caffeine group exceeded that of the placebo group. The intervention group exhibited an average power increase of 0.677 ± 0.44 meters, in contrast to the control group, which demonstrated a lesser increase of 0.223 ± 0.19 meters. The average difference observed between the two groups was 0.454 meters, with a p-value of 0.002 ($p < 0.05$), which suggests a statistically significant difference.

Discussion

Effect of the Caffeine Group on Power Improvement

The greater increase in power observed in the caffeine group indicates that caffeine consumption has a stronger effect in enhancing the power of wrestlers compared to the control group. Not only was this evident in the average change in power, but all wrestlers in the intervention group showed improvements in their chest medicine ball throw test results after consuming caffeine. In contrast, two athletes in the placebo group experienced a

decrease in power. This consistency strengthens the evidence that caffeine has a reliable effect in supporting power enhancement among wrestlers who consume it.

This power increase is linked to caffeine's mechanism of action, which includes stimulating the central nervous system, promoting the release of catecholamines (adrenaline and noradrenaline), and reducing perceived fatigue. These effects collectively boost force production during training. Additionally, caffeine's stimulatory impact on the neuromuscular system enhances motor unit recruitment, directly influencing power output (Pickering & Kiely, 2019). Compared to other studies, these findings suggest that caffeine improves endurance-based sports performance and has a significant effect on explosive sports requiring power, such as wrestling. This interaction is critical because power plays a key role in wrestling techniques like takedowns, throws, and explosive escapes—movements that demand a combination of strength and high speed (Volodchenko, 2024).

Many studies have reported the effects of caffeine on power across various sports disciplines. This study's results align with Negaresh et al. (2018), who examined different doses and administration methods of caffeine in wrestlers. Their findings demonstrated that caffeine, especially when administered gradually or tailored to athlete conditions, helps maintain and enhance physical performance during repeated matches. This evidence supports caffeine's effectiveness for improving power and strength in sports like wrestling.

Furthermore, these results are consistent with Komorowski et al. (2025), who investigated caffeine's effects on combat sports performance. Their research indicated that caffeine doses of 3–6 mg/kg body weight increased strength and power during resistance training. Similarly, Ruiz-Fernández et al. (2023) found that caffeine improved power output in physically active individuals, especially during high-intensity exercise. Overall, these findings reinforce that caffeine can function as an effective ergogenic aid for wrestlers, particularly by enhancing the explosive components of physical performance.

Comparison of Power Improvement Between the Caffeine and Placebo Groups

Caffeine is an active substance known to enhance athletic performance, particularly by increasing muscle strength and power, which are crucial in sports such as wrestling (Grgic et al., 2018). On the other hand, placebo refers to capsules or substances that contain no active ingredients and are used as controls in research to determine whether observed effects are due to the tested substance or merely psychological suggestion (Nemati et al., 2023). Although placebo can produce slight improvements in performance due to psychological effects, its impact is significantly less than that of caffeine, which exerts direct physiological effects. Wrestlers who consume caffeine generally exhibit greater improvements in power compared to those who receive a placebo (Wickham & Spriet, 2018).

These findings are consistent with the study by Nemati et al. (2023), which examined the effects of various doses of caffeine on volleyball athletes' performance. Their results showed

that caffeine consumption more effectively enhanced power than placebo. Similarly, research by Negaresh et al. (2018) investigating different doses and administration methods of caffeine in wrestlers reported that caffeine, especially when tailored to the athlete's condition, helps maintain and improve physical performance during competition. Compared to the placebo group, athletes who consumed caffeine demonstrated better performance times, reinforcing evidence that caffeine is effective in improving power and strength in sports like wrestling.

The results of this study have important practical implications for coaching and athlete performance development, especially in wrestling. Caffeine supplementation at doses of 3–6 mg/kg body weight can be considered as a strategy to enhance athletes' power, particularly before training or competition. Coaches and support staff, such as sports nutritionists, need to understand the safe dosage and optimal timing of consumption to maximize the benefits of caffeine without health risks. Therefore, it is crucial for coaches and sports policymakers to pay greater attention to nutrition and legal supplementation that are proven effective, especially in sports like wrestling that often have limited facilities, to maximize the performance potential of athletes. This approach enhances athletes' performance and fosters a culture of informed decision-making regarding dietary strategies. By prioritizing evidence-based practices, coaches can ensure that their athletes are equipped with the knowledge and tools necessary to excel in their respective sports.

CONCLUSION

Caffeine supplementation at 3–6 mg/kg body weight significantly enhanced upper body power in wrestlers compared to placebo. These findings support caffeine as a safe and effective ergogenic aid for combat sports, though individual variability and study limitations should be considered. Further research with larger samples and longer interventions is recommended. In practical terms, athletes and coaches may consider caffeine as part of evidence-based performance strategies, provided that supplementation is carefully managed with respect to dosage, timing, and individual tolerance.

REFERENCES

Alifiansyah, R. (2024). Hand Grip Strength, Arm Muscles Power, and Flexibility: Key Contributions to Wrestling Athlete Slam Success. *Journal of Sport Sciences and Fitness*, *10*(2). http://journal.unnes.ac.id/sju/index.php/jssf

Baltazar-Martins, G., Brito de Souza, D., Aguilar-Navarro, M., Muñoz-Guerra, J., Plata, M. del M., & Del Coso, J. (2019). Prevalence and Patterns of Sietary Supplement Use in Elite Spanish Athletes. *Journal of the International Society of Sports Nutrition*, *16*(1). https://doi.org/10.1186/s12970-019-0296-5

Bonilla, D. A., Boullosa, D., & Del Coso, J. (2023). Advances in Nutrition, Dietary Supplements and Ergogenic Aids for Athletic Performance: Trends and Future Prospects. In *Nutrients* (Vol. 15, Issue 10). MDPI. https://doi.org/10.3390/nu15102246

Caramoci, A., Ionescu, A. M., Nica, A. S., & Mazilu, V. (2016). *The Influence of Specific Training on Explosive Power in Top Athletes*. 121–127. https://doi.org/10.15405/epsbs.2016.06.17

Davidson, B., Hinks, A., Dalton, B. H., Akagi, R., & Power, G. A. (2022). Power attenuation from restricting range of motion is minimized in subjects with fast RTD and following isometric training. *Journal of Applied Physiology*, *132*(2), 497–510. https://doi.org/10.1152/japplphysiol.00688.2021

Eroğlu, Ş. (2022). Acute Effects of Post-Activation Potentiation on Explosive Strength Performance in Wrestling Athletes. *Pakistan Journal of Medical and Health Sciences*, *16*(5), 532–534.

https://doi.org/10.53350/pjmhs22165532
Grgic, J., Pickering, C., Bishop, D. J., Schoenfeld, B. J., Mikulic, P., & Pedisic, Z. (2020). CYP1A2 Genotype and Acute Effects of Caffeine on Resistance Exercise, Jumping, and Sprinting Performance. *Journal of the International Society of Sports Nutrition*, *17*(1). https://doi.org/10.1186/s12970-020-00349-6
Grgic, J., Trexler, E. T., Lazinica, B., & Pedisic, Z. (2018). Effects of Caffeine Intake on Muscle Strength and Power: A Systematic Review and Meta-Analysis. *Journal of the International Society of Sports Nutrition*, *15*(1). https://doi.org/10.1186/s12970-018-0216-0
Hernández, J. L. H., Santana, G. M., & Quian, Y. R. (2017). Batería de Ejercicios para el Mejoramiento de la Fuerza Explosiva en los Boxeadores del Equipo Nacional. *PODIUM*, *12*(3), 250–259.
Irandoust, K. (2023). The Interplay of Nutrition, Physiology, and Performance in Sports: A Comprehensive Review. *Health Nexus*, *1*(3), 21–30. https://doi.org/10.61838/kman.hn.1.3.3
Jurov, I., Keay, N., & Rauter, S. (2021). Severe Reduction of Energy Availability in Controlled Conditions Causes Poor Endurance Performance, Impairs Explosive Power, and Affects Hormonal Status in Trained Male Endurance Athletes. *Applied Sciences (Switzerland)*, *11*(18). https://doi.org/10.3390/app11188618
Jurov, I., Keay, N., Spudić, D., & Rauter, S. (2022). Inducing Low Energy Availability in Trained Endurance Male Athletes Results in Poorer Explosive Power. *European Journal of Applied Physiology*, *122*(2), 503–513. https://doi.org/10.1007/s00421-021-04857-4
Komorowski, M., Janiszewski, M., Pelczarska, A., Kaczorowski, R., Forenc, T., Hunia, J., Górny, J., Jurek, J., & Kapciak, A. (2025). Can Caffeine Be an Effective Ergogenic Aid in Combat Sports? A Comprehensive Review. *Journal of Education, Health and Sport*, *77*, 57144. https://doi.org/10.12775/JEHS.2025.77.57144
Mota, G. R., & Marocolo, M. (2022). Editorial: Ergogenic Aids: Physiological and Performance Responses. In *Frontiers in Sports and Active Living* (Vol. 4). Frontiers Media S.A. https://doi.org/10.3389/fspor.2022.902024
Negaresh, R., Del Coso, J., Mokhtarzade, M., Lima-Silva, A. E., Baker, J. S., Willems, M. E. T., Talebvand, S., Khodadoost, M., & Farhani, F. (2018). Effects of Different Dosages of Caffeine Administration on Wrestling Performance During a Simulated Tournament. *European Journal of Sport Science*, *19*(4), 499–507. https://doi.org/10.1080/17461391.2018.1534990
Nemati, J., Hemmatinafar, M., Niknam, A., Nikahd, M., Zeighami, N., Imanian, B., Safari, K., Jahaniboushehri, N., & Suzuki, K. (2023). Effects of Different Doses of Caffeine Supplementation on Collegiate Male Volleyball Players' Specific Performance and Skills: A Randomized, Double-Blind, Placebo-Controlled, Crossover Study. *Nutrients*, *15*(18). https://doi.org/10.3390/nu15184049
Pickering, C., & Kiely, J. (2019). Are Low Doses of Caffeine as Ergogenic as Higher Doses? A Critical Review Highlighting the Need for Comparison with Current Best Practice in Caffeine Research. *Nutrition*, *67–68*, 110535. https://doi.org/10.1016/j.nut.2019.06.016
Rachma, D. A., Purwaningtyas, D. R., & Ghifari, N. (2024). Hubungan Pengetahuan Gizi, Asupan Energi, Zat Gizi Makro, dan Latihan Fisik dengan Kekuatan Otot Lengan Atlet Arung Jeram Jabodetabek. *Journal of Sport Science and Fitness*, *9*(2), 95–103. https://doi.org/10.15294/jssf.v9i2.75250
Ruiz-Fernández, I., Valadés, D., Dominguez, R., Ferragut, C., & Pérez-López, A. (2023). Load and Muscle Group Size Influence the Ergogenic Effect of Acute Caffeine Intake in Muscular Strength, Power and Endurance. *European Journal of Nutrition*, *62*(4), 1783–1794. https://doi.org/10.1007/s00394-023-03109-9
Scapec, B., Grgic, J., Varovic, D., & Mikulic, P. (2024). Caffeine, but Not Paracetamol (Acetaminophen), Enhances Muscular Endurance, Strength, and Power. *Journal of the International Society of Sports Nutrition*, *21*(1), 2400513. https://doi.org/10.1080/15502783.2024.2400513
Szerej, K., Dorobek, W., Stankiewicz, K., & Świeczkowski-Feiz, J. (2024). The Role of Caffeine in Enhancing Physical Performance: From Metabolism to Muscle Function. *Journal of Education, Health and Sport*, *59*, 158–165. https://doi.org/10.12775/jehs.2024.59.010
Volodchenko, A. (2024). Model Characteristics of Modern Competitive Activity of the World's Best Athletes in Greco-Roman Wrestling. *Единоборства*, *2(32)*, 4–14. https://doi.org/10.15391/ed.2024-2.01
Wickham, K. A., & Spriet, L. L. (2018). Administration of Caffeine in Alternate Forms. *Sports Medicine*, *48*(S1), 79–91. https://doi.org/10.1007/s40279-017-0848-2
Wilborn, C. D., Taylor, L., & Davis, J. N. (2018). Ergogenic Aids. In *Conditioning for Strength and Human Performance* (pp. 640–666). Routledge. https://doi.org/10.4324/9781315438450-27