DOI: https://doi.org/10.52131/pjhss.2023.1102.0421

Pakistan Journal of Humanities and Social Sciences

Volume 11, Number 02, 2023, Pages 1125–1131
Journal Homepage:
https://journals.internationalrasd.org/index.php/pjhss

Examining the Effects of Caffeine Supplementation on the Arousal of University Football Players

Badar Mohy ud Din[1], Muhammad Zafar Iqbal Butt[2], Yasmeen Tabassum[3]

[1] Ph.D. Scholar, Department of Sports Sciences & Physical Education, University of the Punjab Lahore, Pakistan. Email: badarmohyuddin@gmail.com
[2] Professor, Department of Sports Sciences & Physical Education, University of the Punjab Lahore, Pakistan.
[3] Assistant Professor, Department of Sports Sciences & Physical Education, University of the Punjab Lahore, Pakistan.

ARTICLE INFO

Article History:
Received: April 16, 2023
Revised: June 01, 2023
Accepted: June 02, 2023
Available Online: June 02, 2023

Keywords:
Arousal
Football
Caffeine
Performance
Players

Funding:
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

It is generally known that caffeine has ergogenic characteristics and research has shown that it can improve both the physical and technical aspects of a player's performance. The objective of this study was to discover the impact of caffeine on arousal of male university football players in the South Punjab zone of Pakistan. A randomized placebo controlled, single blind parallel group design was used to perform the study. A total of (n=120) players were selected for the study (age: 22.39 ± 1.69 Years; Height: 172.9 ± 5.85 cm; Body mass 70.12 ± 5.03 kg; Body mass index: 23.45 ± 1.43 kg/m2 Mean ± SD) were distributed into n=4 groups (n=30 in each group) to identify the effect of caffeine on the arousal of the players. In this study (n=3) various doses of caffeine in capsule form were given to three experimental groups. Group A was administered caffeine at 3 mg/kg-1 (LD-CAF: 3 mg/kg-1). Group B was administered caffeine at 6mg/kg-1 (MD-CAF: 6mg/kg-1). Group C was administered caffeine at 9 mg/kg-1 (HD-CAF: 9 mg/kg-1). Whereas, group D was considered a placebo control (PC) group, administered zero mg of caffeine (CAF: 0 mg/kg-1). Felt Arousal Scale (FAS) survey was completed in pre and post-test. Overall, all experimental groups had prominent effects ($P < 0.001$) on the arousal of male university football players. Results also indicated that a high dose (HD) of caffeine 9mg/kg-1 was more effective (131%) than others.

Corresponding Author's Email: badarmohyuddin@gmail.com

1. Introduction

Successful performance in different sports requires a sort of relevant information and choosing actions that are in line with current objectives (Pomportes, Brisswalter, Hays, & Davranche, 2019). The ability of the athlete to manage both physiological and cognitive stresses concurrently has a direct impact on performance. Due to this, it is well-known that modest exercise enhances cognitive performance whereas strenuous or prolonged exercise may result in a decline in cognitive function (Pomportes et al., 2019). According to recent studies by Clark and Mach (2016) and Meeusen and Decroix (2018) dietary supplements may help to reduce central fatigue, which may result from modification in brain neurotransmitters and protect cognitive function when exercising. Caffeine is one of them and athletes regularly ingest it since it has ergogenic benefits for performance. More recently, its enhanced ability to increase cognitive functioning as a result of altering the physiological state of the brain. According to Schulenkorf, Sherry, and Rowe (2016), the world's most popular sport is football. Some of the features that it apart from other games are the size of the playing area, the number of players and the difficulty of the game. Göksu and Yüksek (2018) noted that football players are expected to perform a range of duties at various places on the field, it's critical to understand and assess the physiological and cognitive demands placed on each player. Football has lower scoring than other team sports like basketball or handball, hence the boundaries of success are minor, particularly at the highest level (Mielgo-Ayuso et al., 2019).

The term "caffeine" initially arose from the French word "cafe" and the German word "Kaffee," both of which immediately translate to "coffee. Caffeine and coffee are an example of how Arabia and Turkey, where coffee bushes were first seeded in the sixth century, spread across Europe (Shadaia, 2020). Caffeine is a universally used psychoactive substance and because of its stimulant effects on each of the central and autonomic nervous systems, its activation towards alertness and enhancement capacity regarding the feasibility of intellectual activity many independents use it daily and can be consumed in numerous ways like capsules and beverages (Dietz & Dekker, 2017). For better focus and lower fatigue, lessening the impairment of intentional processes and reasoning behind sleep deprivation, indirectly affecting the release of other neurotransmitters, caffeine actions as an adenosine receptor antagonist and non-selective antagonist to both the A1 and A2 adenosine receptors (Kromhout-Wegewijs, 2021). Caffeine is the widely used drug in the world, taken daily by over 90% of individuals worldwide (Bishop, 2010). According to Del Coso et al. (2012), 75% of athletes who participate in top sports confess to taking drugs either before or during a match. Caffeine was recently removed from the World Anti-Doping Agency's (WADA) list of substances that were not permitted throughout the competition (Wu, 2014).

Additionally, the International Olympic Committee (IOC) indicates that consuming caffeine before exercise in levels between 3 and 6 mg/kg^{-1} improves performance in its most recent agreed statement on dietary supplements (Mielgo-Ayuso et al., 2019). Magkos and Kavouras (2005) and Beaven et al. (2008) indicate that a dose of 9 mg/kg^{-1} taken directly resulted in post-exercise urine caffeine levels below the former International Olympic Committee threshold concentration of 12 mg/L. According to Cappelletti, Daria, Sani, and Aromatario (2015), caffeine is a strong substance that may increase both physical and cognitive performance. Around an hour before physical exercise, caffeine has been given in the form of capsules or beverage, peak plasma levels of caffeine appear 15 to 120 minutes after consumption (Ranchordas, King, Russell, Lynn, & Russell, 2018) and caffeine levels start to decline after three to four hours (Grgic et al., 2019). Caffeine, like the majority of pharmaceutical and dietary additives, affects every cell in your body, including those in muscles, fat and central nervous system (Sellami et al., 2018). The cognitive system is stimulated by caffeine, which makes you more alert and energetic while lessening your level of tiredness (Lima-Silva, Cristina-Souza, Silva-Cavalcante, Bertuzzi, & Bishop, 2021). Barreto et al. (2021) stated that the hormone that sets off the "fight or flight" reaction, epinephrine (also known as adrenaline), is increased by caffeine, which may improve performance. This current investigation purposes to explore the effect of multiple doses of caffeine on the arousal of university level football players.

2. Research Methodology

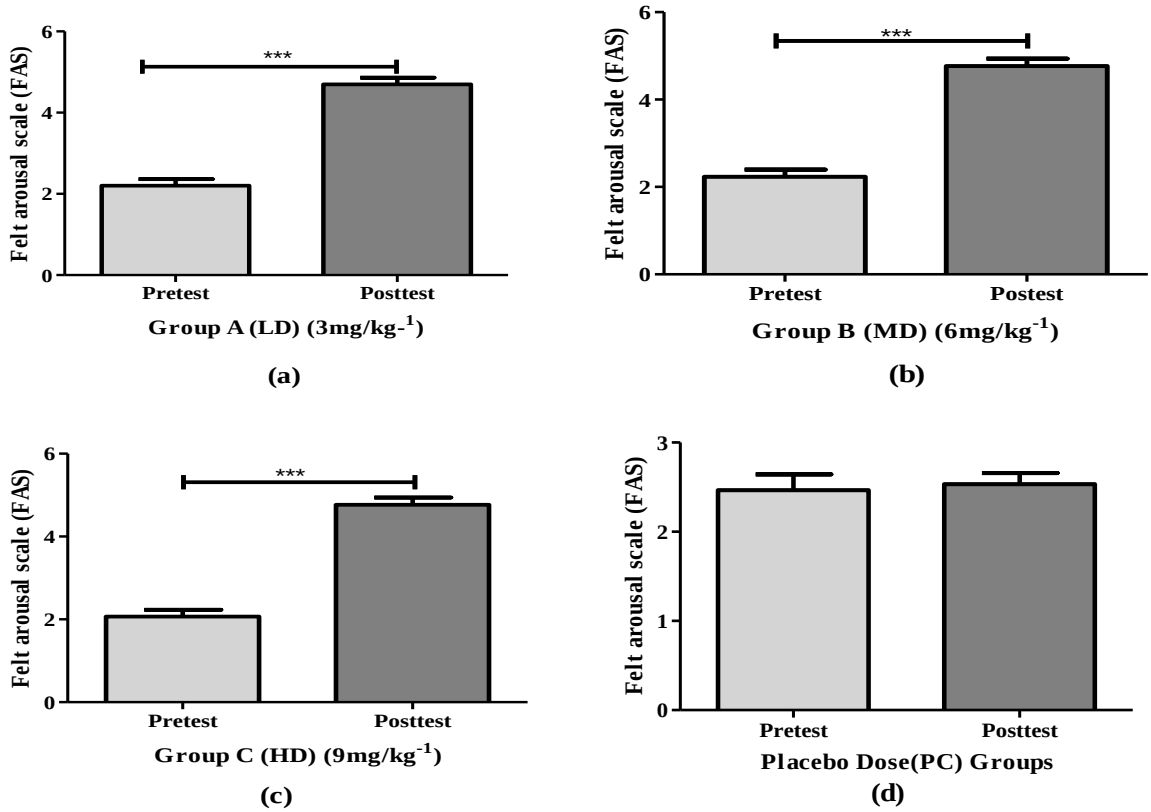
Examining the influence of caffeine supplementation on the arousal of university football players in the South Punjab zone, Pakistan. To conduct this investigation, a randomized trial was carried out, utilizing a placebo controlled and single blind parallel group design. The University of the Punjab Lahore Institutional Ethical Review Board gave its approval to the study (*No. D-342- FIMS;* Dated: 29 September 2022). After completing the questionnaire that was adopted from the AHA-ACSM Health Fitness Facility (Balady et al., 1998), a total of (n=120) players were chosen for the investigation. Participants (age: 22.39 ± 1.69 Years; Height: 172.9 ± 5.85 cm; Body mass 70.12 ± 5.03 kg; Body mass index: 23.45 ± 1.43 kg/m^2 *Mean* ± *SD*) were distributed into n=4 groups through a randomized placebo-controlled trial (n=30 in each group). The survey was done before and after administration of various doses of caffeine. Moreover, the caffeine was administered in three different concentrations (mg). To evaluate the arousal of players, a 4^{th} placebo control group was also managed to whom, treatment of caffeine was not given. The testing was done under the following conditions: temperature +79°^{F}, real feel +79°^{F}, wind speed 1.6 $_{mph}$ *(N),* atmospheric pressure 30_{hg} and humidity 50%. Each condition was experienced by each participant at the same time of day. In their daily routine players received 150.1 ± 39.6 mg/day of caffeine daily. Additionally, for 48 hours before testing, all players were prohibited from engaging in strenuous physical activities and were required to maintain a regular diet. It ensured that caffeine consumption was prohibited for 24 hours prior to the commencement of the experimental session. Group A comprised of 30 participants was administered a low dose of caffeine at 3 mg/kg^{-1} (LD-CAF: 3 mg/kg^{-1}). Group B comprised of 30 participants was administered a medium dose of caffeine at 6 mg/kg^{-1} (MD-CAF: 6 mg/kg^{-1}).

Group C comprised of 30 participants was administered a high dose of caffeine at 9 mg/kg^{-1} (HD-CAF: 9 mg/kg^{-1}). Whereas, group D also comprised of 30 participants was considered a placebo-control group, administered zero mg of caffeine (CAF: 0 mg/kg^{-1}). Subsequently, after oral dose administration, each player was allowed to remain static position for one hour. All these ranges of doses presented above are reported in the literature (Balady et al., 1998; Wu, 2014). It is a well-established fact that plasma caffeine concentration reaches its peak one hour after its ingestion (Graham, 2001). The participants arousal was evaluated during both the pretest and posttest using the Felt Arousal Scale (FAS) (Svebak & Murgatroyd, 1985). The questionnaire was set in English as well as Urdu (the national language of Pakistan) for the convenience of the participants of the study. The FAS assesses changes in perceived arousal before and after caffeine ingestion on a 6-point (0-5) scale. This scale, which is based on Apter's Reversal Theory, is appropriate for use during exercise as it necessitates a subjective evaluation of the participant's felt arousal (Apter, 1989). Whereas low arousal is indicative of tranquility or monotony, high arousal is characterized by enthusiasm. The validity and reliability of the VAS-F in assessing subjective arousal have been established by previous research (Svebak & Murgatroyd, 1985). GraphPad Prism version 6.0 software was used to analyses the data. A two-tailed Paired sample t-test, Analysis of Variance (ANOVA) and Pearson correlation were used to statistically analyses the data from each research parameter.

3. Results

A remarkable increase (P < 0.0001) of 114% was evidenced in felt arousal sale (FSA) after oral administration of 3 mg/kg (Table 1; Figure 1a). Prominent elevation (P < 0.0001) 113% was an indication of felt arousal sale (FSA) after oral administration of 6mg/kg (Table 1; Figure 1b). A significant increase (P < 0.0001) of 131% was marked in felt arousal sale (FSA) after oral administration of 9 mg/kg (Table 1; Figure 1c). Slightly increase of 3% was evidenced in felt arousal sale (FSA) after oral administration of 0 mg/kg placebo control (Table 1; Figure 1d).

Figure 1: Presented Pretest Vs Posttest Score of Felt Arousal Scale (FAS) in Group A, B, C and D



The comparison of Group-A-Pre vs Group-A-Post indicated a significant (P < 0.001) elevation of 113%. Whereas a similar trend of elevation in the comparison of Group-A-Pre vs Group-B-Post (116%), Group-A-Pre vs Group-C-Post (116%), Group-A-Post vs Group-B-Pre (110%), Group-A-Post vs Group-C-Pre (127%), Group-A-Post vs Group-D-Pre (90%), Group-A-Post vs Group-D-Post (85%), Group-B-Pre vs Group-B-Post (113%), Group-B-Pre vs Group-C-

Post (113%), Group-B-Post vs Group-C-Pre (130%), Group-B-Post vs Group D-Pre (93%), Group-B-Post vs Group-D-Post (88%), Group-C-Pre vs Group-C-Post (130%), Group-C-Post vs Group-D-Pre (93%), Group-C-Post vs Group-D-Post (88%) up-regulation was observed.

Table 1: Represented the Results of Paired Sample T-Test Scores on the Felt Arousal Scale (FAS) before and after Caffeine Administration.

Game	Group	*n*	Dose (mg/kg-1)	Test	Felt arousal scale (FAS) Mean ± SEM	%	*P-Value*
Football *n*=120	G-A	30	3	Pretest Posttest	2.20± 0.16 4.70± 0.16	114↑***	< 0.0001
	G-B		6	Pretest Posttest	2.23± 0.16 4.76± 0.17	113↑***	< 0.0001
	G-C		9	Pretest Posttest	2.06± 0.16 4.76± 0. 71	131↑***	< 0.0001
	G-D		0	Pretest Posttest	2.46± 0.17 2.53± 0.12	3↑	0.7

Figure 2: Presenting overall Comparison of Felt Arousal Scale (FAS) Examined by ANOVA Test

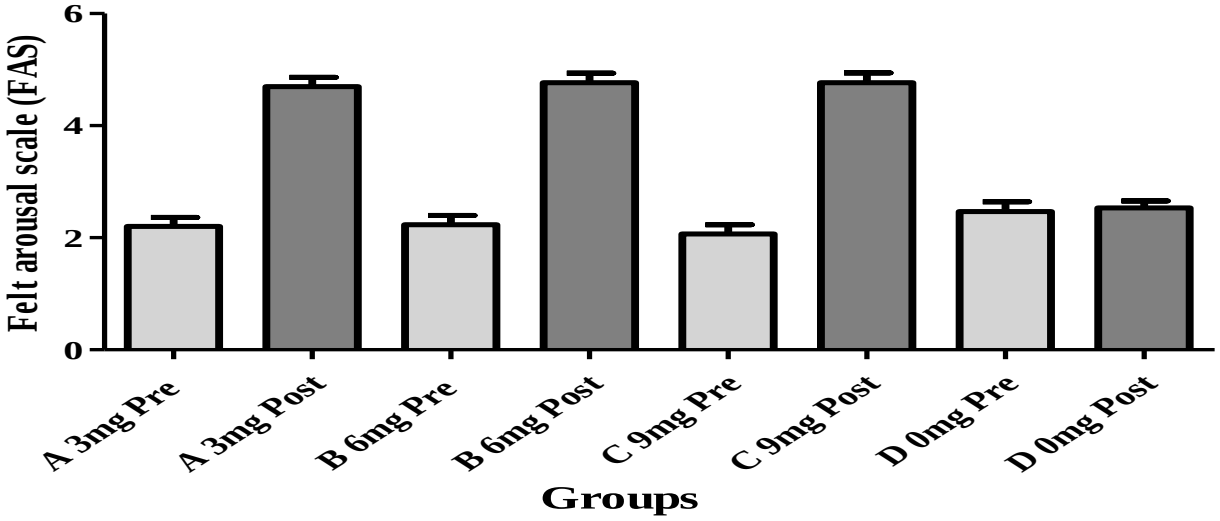


Table 2: Complete Exhibitions of Felt Arousal Scale (FAS) Scores Analyzed by ANOVA.

Group Comparison	Felt arousal scale (FAS) Means ± SEM		Percentage Difference
Group-A-Pre vs Group-A -Post	2.20± 0.16	4.70±0.16	113↑***
Group-A-Pre vs Group-B-Post	2.20± 0.16	4.76±0.17	116↑***
Group-A-Pre vs Group-C-Post	2.20± 0.16	4.76±0.17	116↑***
Group-A-Post vs Group-B-Pre	4.70±0.16	2.23±0.16	110↑***
Group-A-Post vs Group-C-Pre	4.70±0.16	2.06±0.16	127↑***
Group-A-Post vs Group-D-Pre	4.70±0.16	2.46±0.17	90↑***
Group-A-Post vs Group-D-Post	4.70±0.16	2.53±0.12	85↑***
Group-B-Pre vs Group-B-Post	2.23±0.16	4.76±0.17	113↑***
Group-B-Pre vs Group-C-Post	2.23±0.16	4.76±0.17	113↑***
Group-B-Post vs Group-C-Pre	4.76±0.17	2.06±0.16	130↑***
Group-B-Post vs Group-D-Pre	4.76±0.17	2.46±0.17	93↑***
Group-B-Post vs Group-D-Post	4.76±0.17	2.53±0.12	88↑***
Group-C-Pre vs Group-C-Post	2.06±0.16	4.76±0.17	130↑**
Group-C-Post vs Group-D-Pre	4.76±0.17	2.46±0.17	93↑***
Group-C-Post vs Group-D-Post	4.76±0.17	2.53±0.12	88↑***

*** show significance at $P \leq 0.001$

Table 3 displayed the relationship between the Felt Arousal Scale (FAS) Score in the various dose groups. A substantial ($P < 0.05$) positive relationship between Group-A- pretest and Group-C-pretest was found.

Table 3: Represented the Felt Arousal Scale (FAS) Correlation Coefficient for Various Dose Groups

	Group -A- Pretest	Group- A- Posttest	Group -B- Pretest	Group -B- Posttest	Group - C- Pretest	Group -C- Posttest	Group -D- Pretest	Group -D- Posttest
Group A- Pretest	-	.035	.199	.266	.369*	-.104	-.112	-.011
Group A- Posttest		-	.136	.038	.243	-.206	.129	.104
Group B- Pretest			-	.149	.150	.341	-.168	-.154
Group B- Posttest				-	-.022	-.062	.086	-.014
Group C- Pretest					-	.097	.315	-.171
Group C- Posttest						-	.119	-.222
Group D- Pretest							-	.080
Group D- Posttest								-

* show significant at $P \leq 0.05$ (2-tailed)

In the current investigation, all three experimental groups i.e. LD-3, MD-6 and HD-9mg/kg^{-1} caffeine administered group showed noticeable elevation in the Felt arousal scale (FAS) score. In this study, results showed that 9mg/kg^{-1} of caffeine was more effective. The findings of the current investigation are in the accordance with the results of (Ali et al., 2016). Caffeine is a psychoactive stimulant that wakes up the central nervous system (CNS). It also affects how the body wakes up. When you drink caffeine, your body releases catecholamines and cortisol, which raises your baseline activation through things like a faster heart rate (Gilbert, Dibb, Plath, & Hiyane, 2000). Landers, Qi, and Courtet (1985) found that when arousal goes up, attention can narrow, which improves performance up to a point. Moreover, caffeine's impact on the contractile state has been linked to improvements in neuromuscular function and psychomotor coordination (MEDICA-TORINO, 1997).

4. Conclusion

In the current investigation, all three experimental groups presented prominent elevations on the Felt Arousal Scale (FAS). Results also showed that 9mg/kg^{-1} of caffeine was more effective than others. A substantial ($P < 0.05$) positive relationship between Group-A- pretest and Group-C-pretest was found. Furthermore, it is concluded that caffeine had a positive effect on the arousal of university level male football players.

4.1. Practical Application

In this study, footballer was given caffeine in the form of capsules and it was discovered that a dose of 9 mg/kg was the most effective. Caffeine capsule ingestion peaks plasma level after 84–120 minutes. If players are administered caffeine fifteen minutes before the start of the match, caffeine in capsule form begins digestion after 15 minutes, and 15–120 minutes after intake, the plasma caffeine concentration reaches its peak. Within 45 minutes after intake, absorption is almost complete (Kamimori et al., 2002). However, according to FIFA rules, an interval break cannot last more than 15 minutes for players. In the second half of a football match, players feel more tired and need an ergogenic aid for energy. If the player consumes caffeine in this manner, then the caffeine will have a positive effect on the player in the second half of the game.

References

Ali, A., O'Donnell, J., Von Hurst, P., Foskett, A., Holland, S., Starck, C., & Rutherfurd-Markwick, K. (2016). Caffeine ingestion enhances perceptual responses during intermittent exercise in female team-game players. *Journal of sports sciences, 34*(4), 330-341. doi:https://doi.org/10.1080/02640414.2015.1052746

Apter, M. J. (1989). *Reversal theory: Motivation, emotion and personality*: Taylor & Frances/Routledge.

Balady, G. J., Chaitman, B., Driscoll, D., Foster, C., Froelicher, E., Gordon, N., . . . Bazzarre, T. (1998). Recommendations for cardiovascular screening, staffing, and emergency policies at health/fitness facilities. *Circulation, 97*(22), 2283-2293.

Barreto, G., Grecco, B., Merola, P., Reis, C. E. G., Gualano, B., & Saunders, B. (2021). Novel insights on caffeine supplementation, CYP1A2 genotype, physiological responses and exercise performance. *European Journal of Applied Physiology, 121*, 749-769. doi:https://doi.org/10.1007/s00421-020-04571-7

Beaven, C. M., Hopkins, W. G., Hansen, K. T., Wood, M. R., Cronin, J. B., & Lowe, T. E. (2008). Dose effect of caffeine on testosterone and cortisol responses to resistance exercise. *International journal of sport nutrition and exercise metabolism, 18*(2), 131-141. doi:https://doi.org/10.1123/ijsnem.18.2.131

Bishop, D. V. (2010). Which neurodevelopmental disorders get researched and why? *PloS one, 5*(11), e15112. doi:https://doi.org/10.1371/journal.pone.0015112

Cappelletti, S., Daria, P., Sani, G., & Aromatario, M. (2015). Caffeine: cognitive and physical performance enhancer or psychoactive drug? *Current neuropharmacology, 13*(1), 71-88.

Clark, A., & Mach, N. (2016). Exercise-induced stress behavior, gut-microbiota-brain axis and diet: a systematic review for athletes. *Journal of the International Society of Sports Nutrition, 13*(1), 43. doi:https://doi.org/10.1186/s12970-016-0155-6

Del Coso, J., Muñoz-Fernández, V. E., Muñoz, G., Fernández-Elías, V. E., Ortega, J. F., Hamouti, N., . . . Muñoz-Guerra, J. (2012). Effects of a caffeine-containing energy drink on simulated soccer performance. *PloS one, 7*(2), e31380. doi:https://doi.org/10.1371/journal.pone.0031380

Dietz, C., & Dekker, M. (2017). Effect of green tea phytochemicals on mood and cognition. *Current pharmaceutical design, 23*(19), 2876-2905. doi:https://doi.org/10.2174/1381612823666170105151800

Gilbert, D. G., Dibb, W. D., Plath, L. C., & Hiyane, S. G. (2000). Effects of nicotine and caffeine, separately and in combination, on EEG topography, mood, heart rate, cortisol, and vigilance. *Psychophysiology, 37*(5), 583-595. doi:https://doi.org/10.1111/1469-8986.3750583

Göksu, O., & Yüksek, S. (2018). Determination and Comparison of Physical and Physiological Characteristics of Football Players in the U10-17 Categories. *Journal of Education and Training Studies, 6*(4), 171-176.

Graham, T. E. (2001). Caffeine and exercise: metabolism, endurance and performance. *Sports medicine, 31*, 785-807. doi:https://doi.org/10.2165/00007256-200131110-00002

Grgic, J., Sabol, F., Venier, S., Tallis, J., Schoenfeld, B. J., Del Coso, J., & Mikulic, P. (2019). Caffeine supplementation for powerlifting competitions: An evidence-based approach. *Journal of human kinetics, 68*(1), 37-48. doi:https://doi.org/10.2478/hukin-2019-0054

Kamimori, G. H., Karyekar, C. S., Otterstetter, R., Cox, D. S., Balkin, T. J., Belenky, G. L., & Eddington, N. D. (2002). The rate of absorption and relative bioavailability of caffeine administered in chewing gum versus capsules to normal healthy volunteers. *International journal of pharmaceutics, 234*(1-2), 159-167. doi:https://doi.org/10.1016/S0378-5173(01)00958-9

Kromhout-Wegewijs, M. (2021). *Caffeine: a cup of care? An exploration of the relation between caffeine consumption and behavioral symptoms in persons with dementia.* Leiden University,

Landers, D. M., Qi, W. M., & Courtet, P. (1985). Peripheral narrowing among experienced and inexperienced rifle shooters under low-and high-stress conditions. *Research quarterly for exercise and sport, 56*(2), 122-130. doi:https://doi.org/10.1080/02701367.1985.10608446

Lima-Silva, A. E., Cristina-Souza, G., Silva-Cavalcante, M. D., Bertuzzi, R., & Bishop, D. J. (2021). Caffeine during high-intensity whole-body exercise: an integrative approach beyond the central nervous system. *Nutrients, 13*(8), 2503. doi:https://doi.org/10.3390/nu13082503

Magkos, F., & Kavouras, S. A. (2005). Caffeine use in sports, pharmacokinetics in man, and cellular mechanisms of action. *Critical reviews in food science and nutrition, 45*(7-8), 535-562. doi:https://doi.org/10.1080/1040-830491379245

MEDICA-TORINO, E. M. (1997). Metabolic and ergogenic effects of carbohydrate and caffeine beverages in tennis. *J Sports Med Phys Fitness, 31*, 258-266.

Meeusen, R., & Decroix, L. (2018). Nutritional supplements and the brain. *International journal of sport nutrition and exercise metabolism, 28*(2), 200-211. doi:https://doi.org/10.1123/ijsnem.2017-0314

Mielgo-Ayuso, J., Calleja-Gonzalez, J., Del Coso, J., Urdampilleta, A., León-Guereño, P., & Fernández-Lázaro, D. (2019). Caffeine supplementation and physical performance,

muscle damage and perception of fatigue in soccer players: A systematic review. *Nutrients, 11*(2), 440. doi:https://doi.org/10.3390/nu11020440

Pomportes, L., Brisswalter, J., Hays, A., & Davranche, K. (2019). Effects of carbohydrate, caffeine, and guarana on cognitive performance, perceived exertion, and shooting performance in high-level athletes. *International journal of sports physiology and performance, 14*(5), 576-582. doi:https://doi.org/10.1123/ijspp.2017-0865

Ranchordas, M. K., King, G., Russell, M., Lynn, A., & Russell, M. (2018). Effects of caffeinated gum on a battery of soccer-specific tests in trained university-standard male soccer players. *International journal of sport nutrition and exercise metabolism, 28*(6), 629-634. doi:https://doi.org/10.1123/ijsnem.2017-0405

Schulenkorf, N., Sherry, E., & Rowe, K. (2016). Sport for development: An integrated literature review. *Journal of sport management, 30*(1), 22-39. doi:https://doi.org/10.1123/jsm.2014-0263

Sellami, M., Slimeni, O., Pokrywka, A., Kuvačić, G., D Hayes, L., Milic, M., & Padulo, J. (2018). Herbal medicine for sports: a review. *Journal of the International Society of Sports Nutrition, 15*(1), 14. doi:https://doi.org/10.1186/s12970-018-0218-y

Shadaia, C. (2020). Caffeine's Physiological and Psychological Effects.

Svebak, S., & Murgatroyd, S. (1985). Metamotivational dominance: a multimethod validation of reversal theory constructs. *Journal of personality and social psychology, 48*(1), 107. doi:https://doi.org/10.1037/0022-3514.48.1.107

Wu, B. (2014). Dose effects of caffeine ingestion on acute hormonal responses to resistance exercise. *The Journal of sports medicine and physical fitness, 55*(10), 1242-1251.