Journal of Applied Sports Science
June 2024, Volume 14, No. 1
www.jass.alexu.edu.eg

The effect of nutritional supplements on developing swimmer's upper body power.

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Abstract:
Introduction: *caffeine is a psychoactive compound that boasts a venerable history of human consumption and encompasses individuals of various ethnic backgrounds. Caffeine has transcended its role as a mere stimulant and emerged as a noteworthy agent in athletics and physical training. Coaches, athletes, and recreational practitioners have recognized its potential for augmenting performance. Athletes, such as short-distance swimmers, who utilize the anaerobic system are interested in taking supplementation to boost their strength. Thus, the purpose of this study was to examine the effects of caffeine supplementation (250 mg) on upper body strength in swimmers' college students.*
Methods: *twenty-two college age swimmers volunteered for the study. The study design was a randomized double-blind cross-over. This study consisted of two testing sessions. During the first and second testing sessions, subjects were given either coffee with caffeine or placebo. After forty-five minutes, the subjects were then asked to perform isometric hand grip strength.*
Results: *The results show that age mean of the participants was 21 ± 2 years, mean height of 176 ± 7 cm, mean body weight resulted to 84 ± 14.2 kg, and the body mass index concludes 27.1 ± 4.1kg/m^2. Moreover, further significant difference was not observed between placebo with a mean of 36.1 ± 3 kg. vs. caffeine mean of 36.7 ± 3.2 kg in the left-hand grip strength for the set p-value <0.05. Moreover, paired T-test revealed no significant difference between the mean of placebo 37.4 ± 1.5 kg vs. the mean of caffeine 37.7 ± 2 kg in the right-hand grip strength.*
Conclusion: *In conclusion, our present results indicate that consuming of a coffee, with 250 mg of caffeine was not effective to increase upper body strength in male swimmers.*
Keywords:*(Caffeine, Swimming, Power)*

Introduction:

In pharmacology, caffeine is a psychoactive compound that boasts a venerable history of human consumption and encompasses individuals of various ethnic backgrounds. Its incorporation into consumables and potables, such as chocolate, carbonated beverages, coffee, sports drinks, and black and green tea, has left an indelible mark on human culinary traditions. Notably, caffeine has also found a place within the domain of pharmacotherapeutics, featuring as an active constituent in over-the-counter medications such as Excedrin, Anacin, and Midol.

Significantly, caffeine has transcended its role as a mere stimulant and emerged as a noteworthy agent in athletics and physical training. Coaches, athletes, and recreational practitioners have recognized its potential for augmenting performance, attributing its salutary effects to aerobic and anaerobic exercise scenarios. Forman et al. (1995) have asseverated that 70% of youthful athletes worldwide incorporate caffeine into their regimens. An array of scholarly inquiries has illuminated the nexus between caffeine administration, particularly at a dosage approximating 3 mg/kg, and the amelioration of athletic performance (Jenkins et al., 2008; Ivy et al., 1979; Kovacs et al., 1998; Bridge & Jones, 2006).

Nonetheless, the precise explication of caffeine's ergogenic effect and its mechanistic underpinnings remains an enigma that has yet to yield scholarly scrutiny. Caffeine intake has been linked to heightened epinephrine secretion (Graham et al., 1995; Greer et al., 1998). Researchers have also propounded theories concerning caffeine's impact on endurance pursuits, positing that it engenders increased lipid utilization while conserving muscle glycogen stores (Costill et al., 1978). Nevertheless, Graham et al. (2000) have proffered a counterargument, asserting that caffeine does not appreciably elevate fat metabolism. On an alternative front, Kalmar and Cafarelli (1999) have explicated the modus operandi of caffeine in the context of strength exercises, postulating that it heightens performance by augmenting the firing rates of motor units, thereby bolstering force production.

Numerous scholarly investigations have explored the ergogenic potential of caffeine supplementation across a diverse array of physical activities and exercises, with a particular focus on its impact on sports performance. A preponderance of these inquiries has underscored caffeine's propitious influence on aerobic exercises. This contention is buttressed by the findings of Costill et al. (1978), who observed a notable 20% increase in cycle ergometer exercise endurance following the ingestion of 330 mg of caffeine. In a parallel vein, Ivy et al. (1979) documented a substantial elevation in mean power output during a two-hour cycling regimen following caffeine consumption (250 mg), resulting in a 7.4% improvement relative to a placebo. Moreover, MacIntosh & Wright (1995) exposed that caffeine positively impacted the number of times the participants swam in a 1500-m freestyle race. Based on this evidence, caffeine can tentatively increase swimmers' endurance

Caffeine intake can also affect the anaerobic systems. Remarkably, athletes who compete in short-distance swimming utilize the energy provided by anaerobic systems, and caffeine has been found to improve their performance. Jacobson et al. (1992) supported this with their investigation of the effects of caffeine on the strength of highly trained male athletes, showing an increase in maximal strength after caffeine intake at a dosage of 7mg/kg. In contrast, other empirical evidence stated otherwise. Bond et al. (1986) revealed no significant difference in muscular strength among trained and non-trained men who consumed caffeine versus placebo. Moreover, Beck et al. (2006), although caffeine improves upper body strength, it has an insignificant effect on lower body strength.

The disparities in the empirical evidence showed a gap in knowledge on the effect of caffeine activities that require energy from anaerobic systems. Evidence of this remains inconclusive, prompting additional research.

These findings led the researchers to investigate further the role of caffeine in enhancing upper body strength in male swimmers, prompting them to ask the research question, "To what extent does the ingestion of 250mg of caffeine (I) versus placebo(C) exert a substantial impact on diminishing enhancing the athletic prowess (O) of collegiate-level participants (P) in isometric grip strength test (T)?"

The primary objective of this study is to analyze the impact of caffeine supplementation at a dose of 250mg on the college-level swimmers' upper body strength. The researcher hypothesizes that consuming 250 mg of caffeine will significantly improve college-level swimmers' upper body strength.

Methodology:

Study Design:

The researchers utilized a randomized, double-blind crossover design.

Participants:

The participants comprised 22 male swimmers. They were selected from the Department of Physical Education & Sports at the Public Authority for Applied Education and Training. The inclusion criteria are as follows:

1) Male gender.
2) Age range of 18 to 25 years old.
3) Low risk of atherosclerosis based on the American College of Sports Medicine (ACSM) Guidelines for Exercise Testing and Prescription (2006).

Conversely, the exclusion criteria are as follows:

1) An upper extremity injury in the past six months and
2) A clinically diagnosed and documented neurological disorder.

Informed Consent:

The participants were comprehensively oriented on the study's specifications using verbal and written explanations. This encompasses the study objectives and potential risks and benefits. Data protection was also ensured, and the process of result dissemination was explained. The researchers also explained that the participants may withdraw from the study anytime, when necessary, without repercussions.

Data Collection Tools:

Caffeine Consumption Diary:

This validated tool monitors the participants' caffeine intake (Sanchez-Ortuno et al., 2005).

International Physical Activity Questionnaires:

This screening questionnaire identifies the participants' pre-existing medical conditions, which may be presented as confounders in the study.

Upper muscle strength.:

To determine upper body muscular strength, maximal isometric grip strength of both arms was assessed unilaterally using a standard grip strength dynamometer.

Body Mass Index (BMI):

A balance scale was utilized to measure the participants' mass (in kilograms) and height (in centimeters). The height is then converted to meters (m). Then, the BMI was calculated with the formula:

$$\text{BMI}= (mass\ in\ kg)/(height\ in\ m2)$$

Data Collection Procedure:

Initially, the researchers performed a visit and two consecutive testing sessions to collect baseline data on the participants, particularly their height and body mass, using a balance scale. Moreover, the International Physical Activity Questionnaires were utilized to identify the concurring diseases of the participants as well as the informed Consent.

Experimental Procedure:

As mentioned, the study utilized a double-blind crossover design. The participants were randomized to either the caffeine or the placebo group. The experimental and control groups were prohibited from any form of caffeine within the 48 hours before the administration of tests. This includes tea, chocolate, coffee, and soda. Moreover, both groups refrained from consuming nutritional supplements, including but not limited to protein drinks, amino acids, creatine, and vitamins, during the 48 hours leading up to the testing sessions.

Twenty-four hours before the procedure, the participants answered a questionnaire on exercise and diet. A diet plan was followed, and intense exercise was prohibited. Then, the experimental and placebo groups were then provided with the drink for 45 minutes before isometric grip strength. The experimental group was given two shots to drink with 250mg of caffeine (Nespresso® Ispirazione Palermo Kazaar). In contrast, the placebo group was given two shots of decaffeinated coffee with 0 mg caffeine content (Nespresso® Ispirazione Ristretto Decaffeinato) but with the same taste (placebo). Both drinks have similar tastes.

To measure hand grip strength, the researcher used the Jamar hydraulic hand dynamometer (Patterson Medical, Warrenville, IL, USA). The researcher calibrated the dynamometers before the first trial. subjects were instructed to follow the American Society of Hand Therapists' recommendation where they should be seated on a standard height chair without armrests. Each participant was seated with one shoulder adducted and neutrally rotated, elbow flexed at 90°, forearm in a neutral position, and wrist in 0°–30° dorsiflexion and 0°–15° ulnar deviation. In order to obtain an optimal grip position for each participant, the grip handle of the dynamometer was adjusted based on the participant's hand size. Each subject had 3 trials for each hand, with a 30 second rest between the measurements to avoid fatigue. The researcher used the best value of the trials.

Statistical Analysis:

Statistical tools were utilized for data analysis. A paired T-test was used to examine the differences in mean values of the independent and dependent variables. Moreover, the distribution of the data set was analyzed through Levene's Test. Data significance was set at a p-value of <0.05 in all analyses. Lastly, the Statistical Package for the Social Sciences (SPSS) version 22.0 was utilized to finalize the analysis.

Results:

Initially, there were 23 participants. However, two participants withdrew, and we now have 22 participants. Table 1 demonstrates that the mean age of the participants is 21 ± 2 years, the mean height is 176 ± 7 cm, the mean body weight is 84 ± 14.2 kg, and the BMI is 27.1 ± 4.1kg/m^2.

Moreover, further significant difference was not observed between placebo with a mean of 36.1 ± 3 kg. vs. caffeine mean of 36.7 ± 3.2 kg in the left-hand grip strength for the set p-value <0.05. Moreover, paired T-test revealed no significant difference between the mean of placebo 37.4 ± 1.5 kg vs. the mean of caffeine 37.7 ± 2 kg in the right-hand grip strength.

Table (1)
Characteristics of study participants (n=22)

Variables	***Mean ± SD***	***Range***
Age (years)	***21 ± 2***	***18 - 25***
Body Mass (kg)	***84 ± 14.2***	***74.9 - 88.0***
Height (cm)	***176 ± 7***	***170 - 188***
BMI (kg/m^2)	***27.1 ± 4.1***	***21.8 - 29.4***

Data mean ± SD and range, BMI (kg/m^2) = Body Mass Index.

Table (2)
Right- and Left-Hand Grip Strength (Kg) in group of swimmer's college age students after placebo and caffeine ingestion(n=22)

Variables	***Placebo***	***caffeine***	***P-Value***
Right Hand Grip Strength (Kg)	***37.4 ± 1.5***	***37.7 ± 2***	***>0.05***
Left Hand Grip Strength (Kg)	***36.1 ± 3***	***36.7 ± 3.2***	***>0.05***

*Statistically significant differences between groups
Values are means ± SD.
$p<0.05$.

Figure (1)
Right Hand Grip Strength (Kg) in group of swimmer's college age students after placebo and caffeine ingestion.

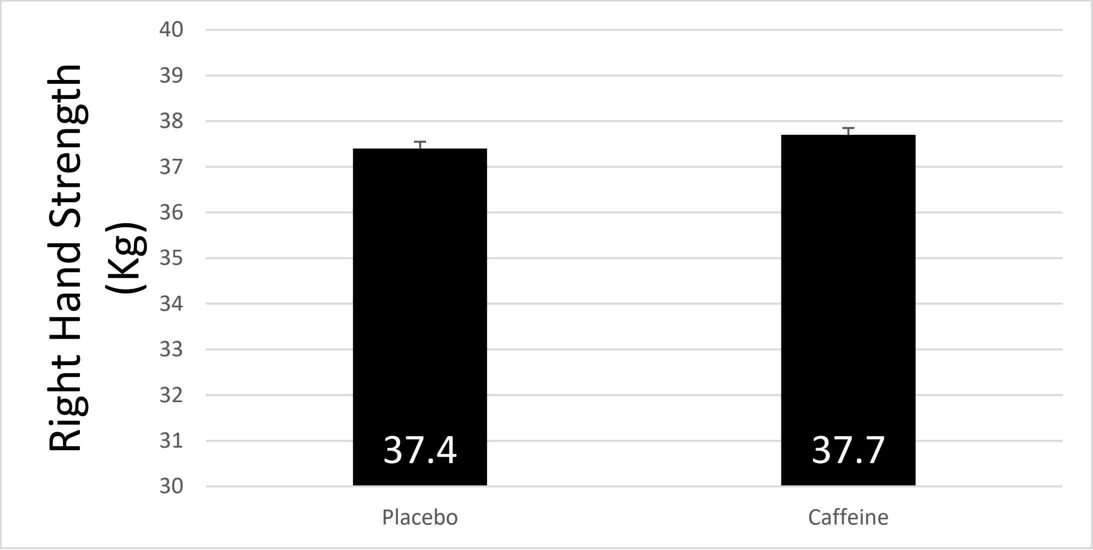
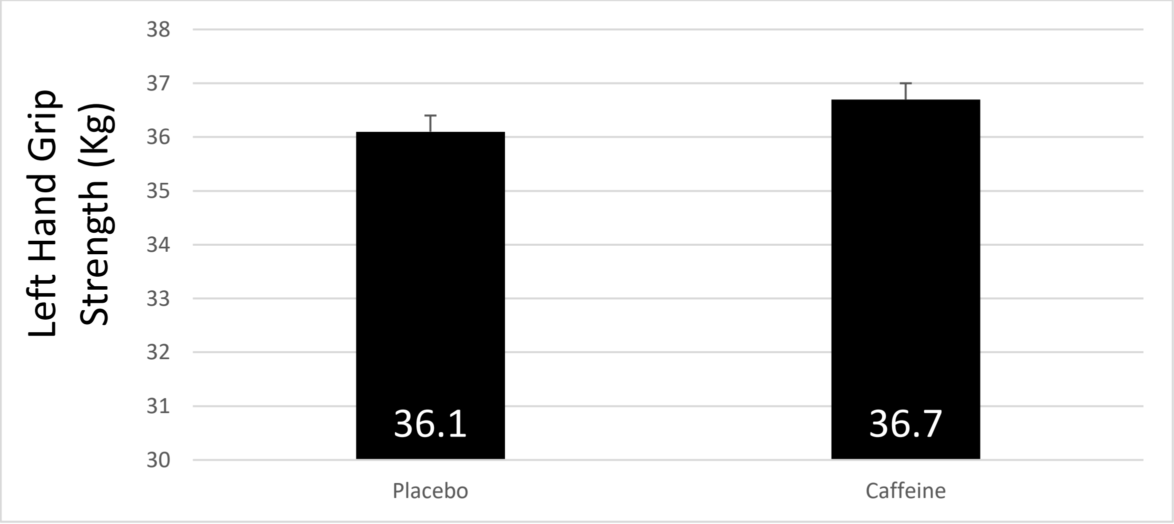


Figure (2)
Left Hand Grip Strength (Kg) in a group of swimmer's college age students after placebo and caffeine ingestion.



Discussion:
The muscle strength plays a crucial role to increase the swim velocity. For this reason, the primary objective of this study is to analyze the effects of coffee containing caffeine on the swimmers' upper body strength. The initial number of participants was 23, reduced to 22.
Primarily, the findings revealed that consuming caffeine-containing drinks did not improve college age swimmers upper body strength. This leads to rejecting the alternative hypothesis. The findings are in contrast with the established data in the literature. Beck et al. (2006), observed an improvement in the upper body strength, it has an insignificant effect on lower body strength. The study results are consisted with Bond et al. (1986) who revealed no significant difference in muscular strength among trained and non-trained men who consumed caffeine versus placebo.

Conclusion:
Our study's results diverge from our initial hypothesis, as they suggest that the consumption of a caffeinated

beverage prior to isomeric hand grip strength did not result in a notable increase in upper body strength or a considerable improvement in the athletic abilities of the participants. These findings contrast with prior research indicating caffeine's positive influence on upper body strength.

Several factors could be responsible for these outcomes. The amount of caffeine ingested, the timing of its consumption, or individual differences among participants contributed to the observed results. Additionally, the unique demands of upper body strength may differentiate it from other athletic activities influenced by caffeine.

Nonetheless, our study had several limitations, including a reduced sample size due to participant attrition, focusing solely on male participants, and utilizing a specific caffeine source. Furthermore, our investigation exclusively assessed short-term effects, and the effects of long-term caffeine supplementation may yield dissimilar outcomes. As well as the plasma or urinary caffeine concentrations were not measured.

In summary, our study's data did not support the notion that consuming 250mg of caffeine substantially enhances upper body performance among swimmers collegiate-level participants in a isomeric hand grip strength. However, further research is warranted, given the multifaceted nature of caffeine's impact on athletic performance. Future studies should explore varying caffeine dosages, timing strategies, and participant characteristics. These findings contribute to the ongoing discourse on caffeine's potential ergogenic effects in sports and underscore the importance of continued research to gain a more comprehensive understanding of its role in enhancing athletic performance.

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