



Effects of Caffeine on NFL Combine-Like Tests in Undergraduate Students

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Abstract

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Caffeine is a widely used stimulant with performance enhancing characteristics. The effectiveness of caffeine in various circumstances, such as within a series of physiological assessments which utilize different energy systems, is less clear. The purpose of this research study was to determine the effectiveness of caffeine on different areas of the NFL combine-like tests, specifically the 40-yard dash (40-YD), standing broad jump (SBJ), and YMCA bench press test (YMCA-BP). Thirty-three healthy participants (19 men, 14 women: age 20.42 ± 1.23 yrs) consumed a 200mg caffeine and placebo pill on two occasions. The participants were randomly assigned to which they received first and blinded to the caffeine or placebo. Forty-five minutes after taking the pill, participants performed the YMCA-BP (80lbs men, 35lbs women: 30 reps/min), the SBJ (3 attempts with best jump recorded), and ran the 40-YD (2 attempts, best recorded). Participants returned one week later, consumed the other pill, and performed the tests. Results from each trial were compared using a paired samples *t*-test. The results revealed no difference in YMCA-BP or SBJ. However, results were better with caffeine for the 40-YD (caffeine 5.69 ± 0.86 ; placebo 5.81 ± 0.89 ; $p < 0.001$, mean difference = -0.118 , 95% CI $-0.109, -0.056$, Cohen's $d = 0.68$). With better performance specific to 40-YD times after caffeine, these results suggest short, explosive activities may be enhanced following caffeine consumption. Further research is needed.

Keywords: Sports, performance, NFL-combine, caffeine

Introduction

The top 320 college football players are invited to the NFL Combine to compete in events such as the 40-yard dash, standing broad jump and bench press test to test the speed, strength, and power of the athletes. At the highest level, the smallest difference in performance can determine an athlete's draft pick. Caffeine may provide an athletic advantage, so it is important to assess the impact of caffeine on the performance in the events at the NFL Combine.

Caffeine (1,3,7-trimethylxanthine) acts as a phosphodiesterase (PDE).¹ PDE's break down cyclic adenosine monophosphate (cAMP),² a secondary messenger that stimulates lipolysis.³ The consumption of caffeine inhibits PDE which in turn increases intracellular cAMP levels² and enhances fat oxidation,^{2,4} shifting the origin of ATP production away from glycogen stores. For an exercise such as the bench press, which depends on repeated muscle contractions rather than explosive power, this mechanism is particularly relevant. Increased lipolysis may preserve

glycogen for later in the exercise, potentially delaying muscular fatigue and allowing the athlete to perform additional repetitions.

While muscular fatigue may not play as significant a role in events such as the standing broad jump or the 40-yard dash, caffeine's other physiological effects become more relevant. Elevated cAMP levels have been shown to increase circulating catecholamines, including epinephrine and norepinephrine.⁵ These hormones enhance calcium availability within the cytoplasm of muscle fibers due to a decreased reuptake by the sarcoplasmic reticulum,^{6,7} promoting stronger and more forceful contractions that can translate into greater explosive power. This may result in longer jump distances or more powerful strides. Importantly, caffeine's primary mechanism is as an adenosine A1 and A2A receptor antagonist.⁷⁻⁹ By blocking these receptors in the central nervous system, caffeine reduces the inhibitory effects of adenosine, leading to elevated arousal.¹⁰ This enhanced central drive allows for faster reaction times, improved motor unit recruitment, and greater focus during rapid, high-intensity movements.⁷ Because the standing broad jump and 40-yard dash require precise coordination and timing among multiple muscle groups, increased neural activation and communication between the brain and muscles may further enhance performance and movement efficiency, making these events potentially sensitive to the biochemical effects of caffeine.

Studying the effects of caffeine on performance is particularly relevant for the college-age population, who tend to consume caffeine at high rates. NFL Combine athletes, typically between 21 and 24 years old, fall within this age range. Quantifying how caffeine affects their performance is valuable, especially if they consume it before their events. Understanding the degree of performance enhancement relative to their baseline can offer insights into its potential benefits regarding athletic performance. The purpose of this study was to test whether 200 mg of caffeine improves 40-YD, SBJ, YMCA-BP in college-aged adults in a randomized crossover trial. Researchers hypothesize 200 mg of caffeine would result in significantly greater performance in the 40-YD, SBJ, and YMCA-BP compared to a placebo.

Methods

Participants

This research study was approved by the UNC Wilmington Institutional Review Board (IRB) with the protocol number H23-0763. Participants

Participants in this study were college students at the University of North Carolina Wilmington between the ages of 18 and 25, as college-aged athletes compose those preparing to enter the NFL Combine. Recruitment occurred through emails sent to every student in the College of Health and Human Services. Participants that were excluded from taking part in this research study if they met any of the following criteria: if the participant is or may be pregnant, if they were over the age of 25 or under the age of 18, have previously had adverse or sensitive reactions to consuming caffeine, if the participant failed the PARQ, or if they were unable to perform the exercise tests. Additionally, exercise science majors were targeted by additional recruitment attempts through specific courses to increase the sample size. A priori power analysis was not conducted prior to conducting this research study. The goal was to reach at least 20 participants due to recruitment challenges. Research comparing caffeine to placebo has been conducted using similar or smaller sample sizes. For example, Woolf, Bidwell, and Carlson assessed the impact of caffeine on the 40-yard dash, 20-yard shuttle, and bench press with a sample size of 17.¹¹ Time trials in cyclists have

also utilized small sample sizes when comparing caffeine to placebo. Thirteen cyclists performed 4-km time trials utilizing placebo and caffeine to determine its effectiveness on performance.¹² This research was carried out fully in accordance with the ethical standards of the *International Journal of Exercise Science*.¹³

Protocol

Upon showing interest in the study, potential participants were provided with a Physical Activity Readiness Questionnaire (PARQ). Participants who completed the PARQ without indicating signs or symptoms of cardiovascular disease or other medical conditions of concern were then provided with details about the study via an informed consent. Completion of the informed consent led to participants signing up for two separate assessment times over the course of approximately two weeks. Participants were instructed to not exercise or consume caffeine within 24 hours prior to their assessments. Participants arrived at the assessment and were given either a caffeine pill (200 mg) or a placebo, in random order. The placebo was a zero-calorie cellulose capsule with no active ingredients, the same size and color as the caffeine capsule. Participants were blinded to the caffeine or placebo at both visits. Participants waited 45 minutes prior to performing three modified NFL combine tests: the YMCA bench press test, the standing broad jump, and the 40-yard dash. The YMCA bench press test (YMCA-BP) (Life Fitness, Hammer Strength barbell, weights, and bench. Rosemont, IL) involved participants lifting a bench press bar (80-lbs for men and 35-lbs for women) to a cadence of 60 beats per minute (30 repetitions per minute) until they could no longer match the speed of repetitions, or failure (Smart Metronome & Tuner iPhone App, Ihara Products Co., Ltd.). For the standing broad jump (SBJ), the participants stood behind a line and jumped as far out as they were able. Participants started from a stationary position. Participants performed three trials and the farthest distance from the starting line to the back of the heel was recorded (Power Systems Long Jump Tester, Knoxville, TN). For the 40-yard dash (40-YD), participants sprinted as fast as they could through the finish line. Timing was obtained using a handheld stopwatch. Participants began in whatever stance suited them, with the front of their shoes/toes behind the line. The stopwatch was started when their foot touched/bypassed the starting line. Participants performed two trials and the fastest time was recorded. Hand timing has been found to have high reliability, among experience and novice timers, but does tend to produce consistently faster sprint times compared to electronic timing.¹⁴ Participants took a 90 second rest interval between drills. The protocol used was a modified from the NFL combine, designed specifically for college students who do not have the same strength, endurance, and explosiveness as a college athlete. Although the exercises were tailored differently than the NFL combine, the experiment still allowed for an accurate representation of caffeine's effectiveness on similar tests.

After approximately one week, the participants returned for the second intervention. They received the opposite pill from their first session. Again, they waited 45 minutes before starting the same series of tests in the same order. Participants were provided with the same instructions for each exercise as the week prior. Before each intervention, participants had the opportunity to warm up during the 45-minute waiting period. This warm-up included activities such as, but not limited to stretching, yoga, breathing exercises, and warming up on the bench press.

Statistical Analysis

Statistical analyses were performed using Excel for Microsoft 365 (Microsoft Excel (Microsoft Corp, Redmond, WA). To compare caffeine and placebo on the NFL combine-like drills, paired samples

t-tests were performed. Pooled data was compared for the 40-YD and SBJ but data was analyzed by sex for the YMCA-BP. The significance level (*p*-value) was set at 0.05 for all comparisons following adjustment for multiple comparisons (Holm). Assumptions were checked.

Results

Data was collected on 33 participants (19 men and 14 women) with an age of 20.42 ± 1.23 years. Participants were primarily exercise science majors with comfort and experience in the gym. Participants reported consuming an average of 89.35 mg of caffeine per day outside the study itself. The 40-yard dash revealed a significantly faster time of 5.69 ± 0.86 seconds after consuming caffeine compared to 5.81 ± 0.89 seconds following the placebo ($p < 0.001$, mean difference = -0.118, 95% CI -0.109, -0.056, Cohen's *d* = 0.68). See Figure 1.

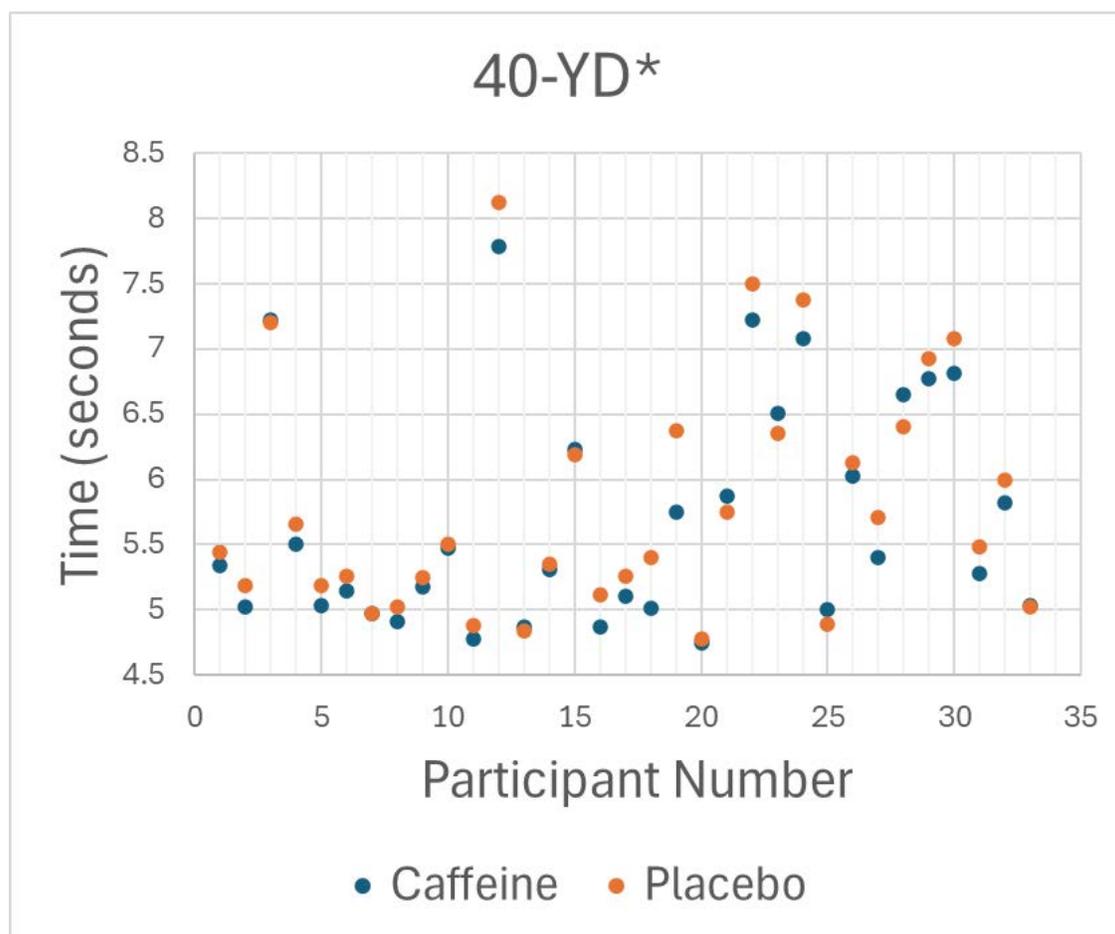


Figure 1. 40-YD time in placebo vs. Caffeine group (n=32).

The standing broad jump revealed no significant difference between caffeine and placebo, following the Holm *p*-value adjustment for multiplicity, with caffeine resulting in a distance of 78.12 ± 17.56 inches and placebo a distance of 76.76 ± 17.93 ($p = 0.136$, mean difference = 1.36, 95% CI 0.11, 2.62, Cohen's *d* = 0.39). See Figure 2.

monitoring list, but neither lists a limit for urinary concentration, nor considered to be a banned substance.¹⁶ According to the American College of Sports Medicine (ACSM), a person who weighs about 155 pounds would have to consume five to six 8-ounce cups of coffee within an hour and a half prior to testing in order to test positive for too much caffeine.¹⁸

Caffeine has been used for many years for aerobic sports such as running, cycling, and swimming. It has continuously shown improvement when used. There have also been studies that have shown improvement in anaerobic sports due to stimulating the central nervous system.

Results from this study show that caffeine does significantly improve the participants speed for the 40-YD. These findings support the notion that caffeine's role as an adenosine receptor antagonist enhances central drive and neural activation, thereby improving short, explosive movements. The significant improvements observed in acute anaerobic tasks suggest that heightened neural activation contributes to superior performance in these contexts. These results suggest that athletes may benefit from consuming caffeine 30–60 minutes before engaging in short, explosive efforts. On average, participants improved an entire tenth of a second in the 40-YD, from a mean of 5.81 seconds with the placebo to 5.69 seconds with the caffeine, an outcome that could determine the difference between a race or game. In addition, the mean distance jumped was 76.76 inches using the placebo and 78.12 inches with ingestion of caffeine.

However, despite average values being slightly higher when participants consumed caffeine, no significant effects were observed in the bench press trial, which challenges the hypothesis that increased lipolysis and glycogen sparing lead to greater muscular endurance. However, because this study did not include biological or mechanistic measures such as ratings of perceived exertion (RPE), heart rate (HR), blood pressure (BP), electromyography (EMG), or blood lactate levels in any of the three exercises, future research incorporating these variables would be necessary to confirm the underlying mechanisms. With caffeine significantly improving in 40-YD times, consuming caffeine prior to exercise does show benefits. If an athlete is competing, or the general population going to the gym to workout, caffeine consumption does help to improve some areas of physical exercise, and of those tested, it did not seem to harm their performance either even if improvement was not determined.

A study conducted at Arizona State University assessed caffeine's effect on collegiate football players' ability to complete other NFL Combine like drills. The participants in the study all consumed relatively low amounts of caffeine each day, consistently. Each athlete completed two interventions, one with caffeine (5 mg/kg of body weight) and one without. Each participant then completed the 40-yd dash, 20-yd shuffle, and bench press test. They used the Borg-scale to determine the rate of perceived exertion (RPE) after completion of each test. Additionally, heart rate and blood pressure were monitored before and after individual assessments. Previous research suggests that caffeine has a positive effect as an ergogenic aid in aerobic exercise. This study examined the anaerobic effects. In this study, not one of the tests improved significantly. However, 59% of the participants did better on the bench press and 40-yard dash. While not enough to reject the null, it is possible that with a larger sample size, significant improvements with caffeine consumption could be produced. Similarly to our study, while there was no statistically significant data, performance did improve in the 40-yard dash and bench press.¹¹

Additional research has examined caffeine's effect on strength and repetition sustainability. Novice body builders were participants in a study in which 5 sets of bench and leg press were

performed with 6 mg caffeine/kg of body weight and without caffeine consumption. In this double-blind study, each participant would complete a bench press and leg press at 80% of their 1- RM for a total of 5 sets. The research team evaluated each set by muscular strength, repetition sustainability, and volume of work. The result was an increase in repetition sustainability, muscular strength, and volume of work while utilizing caffeine compared to the placebo. This research agrees with our results showing the improvement of performance with caffeine intake.¹⁹

This research could be continued. Future research should take into account participants' body weight as well as habitual caffeine consumption. Additionally, conducting a similar study with actual NFL Combine athletes to see how the outcomes actually improves at the NFL combine would be very interesting. High level athletes, when possible, put everything into practice and games. Identifying additional ways in which they can improve their skills could mean the difference between them getting drafted or not.

This study included numerous limitations. Caffeine expectancy and/or withdrawals were not assessed. Participants were asked to abstain from caffeine 24 hours prior to each assessment, however, there may have been a residual effect of caffeine or withdrawal which may have impacted results. Single rather than double-blind was used without a blinding check and the study utilized only a single fixed dose. Although a double-blind protocol is superior, research utilizing caffeine has been conducting using a single-blind method.²⁰ In addition, the warmup was not standardized. The sample size was small and no power analysis was conducted. Despite these limitations, this small study contributes to the literature on caffeine and performance and limitations listed may be addressed in future studies.

Caffeine may help with aerobic as well as anaerobic exercise and sports. However, knowing how much caffeine is too much is very important. Caffeine is a diuretic and consuming too much of it can severely dehydrate athletes. This could lead to a series of other issues for the athletes especially if they are competing outdoors, in pads, or working extremely hard.⁵

Consuming caffeine prior to participating in physical activity does have the ability to improve outcomes within different types of exercise, especially those that involve speed and explosive movements. With caffeine being one of the most commonly and consistently used stimulants, it is important to research how we can use it most effectively. Athletes can use the findings of this research and others to possibly have a competitive advantage over their opponents.

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