

Effects of Caffeinated Chewing Gum on Shot Put Performance

Document Date: Jan 05 2026

IRB approved date: August 1, 2025

Project summary

15-20 active throwers who have received professional shot put training are expected to be recruited for the study. In a randomisation crossover design, the study was divided into caffeinated chewing gum trial (CCG) and placebo trail (PL). Participants wore a heart rate monitor to record their heart rate and heart rate variability during the experiment, and were given either a caffeinated chewing gum containing 3 mg/kg of body weight (CAP trial) or a placebo chewing gum, and rested for 15 minutes. After the warm-up, the athletic ability test and shot put performance were conducted in order. Saliva samples were collected for analysis of caffeine and α -amylase before and at the end of the experiment.

Introduction

The shot put is a discipline emphasizing explosive power, requiring athletes to propel the shot to a standard height and angle within a brief timeframe to achieve optimal distance. Previous studies have shown that increased sympathetic nervous system activation can effectively enhance energy output during maximal exercise intensity and improve torque during isometric contraction of the quadriceps femoris. Research on caffeine and shot put performance remains limited. In a 2012 published in 2012, morning caffeine supplementation significantly improved alertness and throwing distance in shot put athletes. Another study found that 3 mg of caffeine per kilogram of body weight effectively enhanced several physiological indicators related to explosive power, but only marginally affected shot put distance. Considering the combined findings of these two studies, current research has not specifically examined the effects of caffeine supplementation on autonomic nervous system changes or blood and saliva biochemical indicators. Therefore, future studies that strengthen the investigation of these two areas would still hold potential for publication.

Methods

Study design

This study employed a randomized crossover, double-blind experimental design, divided into two trials: the caffeinated chewing gum trial (CCG) and a placebo trial (PL). All trials were scheduled for completion during the off-season. Off-season training featured similar schedules Monday through Friday, with weekends reserved for

rest and recovery. Consequently, trials commenced on Mondays following athletes' return from rest periods to ensure consistent pre-trial recovery states. Following the first trial, after 5 days of rest and 2 days of recovery, the second and third trials will be conducted immediately. The trial sequence will be randomized by computer.

Participants

This study plans to recruit 15-20 active throwing athletes with professional shot put training as subjects. Inclusion criteria are: 1. At least 6 years of training in shot put or related track and field throwing events. 2. No cardiovascular or joint diseases. 3. Recovered from sports injuries such as strains or sprains for at least 3 months. Exclusion criteria are: 1. Non-specialized track and field throwers. 2. Presence of cardiovascular or joint diseases, or any conditions that may be exacerbated by exercise. 3. Female and underage subjects. 4. Individuals with caffeine sensitivity. The consent form is completed after the participant has given consent. This study was conducted following the Declaration of Helsinki.

Protocol

All experiments are scheduled to commence at 3:00 PM. Upon arrival at the assembly area, participants must rest in a seated position for at least 10 minutes. Subsequently, saliva samples will be collected for subsequent biochemical analysis. Concurrently, participants will wear heart rate monitors to record heart rate and heart rate variability changes throughout the experiment. Immediately after, participants chewed caffeine gum (3 mg/kg body weight) for 10 minutes (CCG trial) or caffeine-free placebo gum (3 mg/kg body weight) for 10 minutes (PL trial) before discarding it. They then began a dynamic warm-up lasting approximately 15 minutes. For caffeine gum, chewing for 10 minutes followed by a 15-minute rest period allowed for peak salivary caffeine concentration. Following the warm-up, a second saliva sample was collected. After sample collection, participants sequentially performed maximum grip strength, vertical jump, and squat tests. After testing, subjects rested for 5 minutes before performing the shot put-specific test. Following this test, participants provided another saliva sample, concluding the entire testing protocol.

Caffeine and placebo gum

The caffeinated chewing gum employed in the present study (Military Energy Gum, Arctic Mint flavour; Stay Alert, Chicago, USA) has been utilised in previous studies(1, 2). It is estimated that a single piece of gum contains approximately 5 grams and 100 milligrams of caffeine. The placebo gum was a commercially available blue mint gum

(Lotte Gum Mint., Ltd., Tokyo, Japan). In order to administer a dose of 3 mg/kg of caffeine per unit of body weight, it was necessary to crush, grind, blend, reshape and flavor all chewing gums with 0.3 g of peppermint-flavored powder. The process was designed to ensure that the new chewing gums were comparable to the original in terms of appearance, color, flavor, weight and size. Previous studies have demonstrated that this method renders it impossible for the participant to distinguish the type of gum (1, 3).

Saliva sample collection and analysis

Saliva samples were stored in a refrigerator at -80 degrees immediately after collection. For analysis, samples were thawed and centrifuged at 4000 rpm for 5 min. 500 μ L of saliva samples were transferred to glass tubes for mass spectrometry analysis and Enzyme-linked immunosorbent assay (ELISA) analysis respectively. The analysis of saliva α -amylase concentration was conducted utilising an enzyme-linked immunosorbent assay (ELISA) with commercially available reagents (Neogen Corporation, Kentucky, USA; Salimetrics LLC, State College, PA, USA).

Statistical analysis

All data are presented as means \pm standard deviations. The Shapiro–Wilk test was utilised to evaluate the normality of the data. The grip strength and number of fall on each rounds between the two trials were analyzed using paired t-tests. The saliva caffeine and α -amylase concentration and RPE were analyzed using two-way ANOVA with repeated measures. If the interaction effect (trial \times time) were significant, the Bonferroni method was used to perform post hoc comparisons. Effect sizes were calculated using Cohen's d to quantify the magnitude of observed effects and defined as trivial (<0.20), small ($0.20\text{--}0.40$), moderate ($0.40\text{--}0.80$), and large (>0.8), respectively. The power value of each data was conducted using G*Power 3.1.9.6 software (4)

Reference

1. Shiu Y-J, Chen C-H, Tao W-S, Nai H-F, Yu C-Y, Chiu C-H. Acute ingestion of caffeinated chewing gum reduces fatigue index and improves 400-meter performance in trained sprinters: a double-blind crossover trial. *Journal of the International Society of Sports Nutrition*. 2024;21(1):2414871.
2. Morris C, Viriot SM, Mirza QUF, Morris GA, Lynn A. Caffeine release and absorption from caffeinated gums. *Food & function*. 2019;10(4):1792-6.
3. Liu H-S, Liu C-C, Shiu Y-J, Lan P-T, Wang A-Y, Chiu C-H. Caffeinated Chewing Gum Improves Basketball Shooting Accuracy and Physical Performance Indicators of Trained Basketball Players: A Double-Blind Crossover Trial. *Nutrients*. 2024;16(9):1256.
4. Faul F, Erdfelder E, Lang A-G, Buchner A. G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior research methods*. 2007;39(2):175-91.