No "jitters" but no energy from a commercially available energy drink.

Original Research

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Abstract

Introduction: The purpose of this study was to determine the effects of an energy drink (JOCKO GO) on mood, sustained attention/reaction time, and hand steadiness.

Methods: A total of 29 active men (n = 9) and women (n=20) (mean ± SD: age 22 ± 5 yr.; height 168±8 cm; body mass 68.2 ± 12.8 kg; lean body mass 51.9 ± 15.0 kg; fat mass 15.4 ± 6.8 kg; percent body fat 22.6 ± 8.9%; total body water 38.6 ± 8.6 liters) completed this randomized, crossover, counterbalanced trial. Each subject consumed either one can (355 ml) of the energy drink or nothing (i.e., control condition). Each assessment (Profile of Mood States, Psychomotor Vigilance Test, and Hole Type Steadiness Tester) was made 30-60 minutes after consuming the energy drink, whereas, in the control condition, assessments were made 30-60 minutes after arrival to the clinical site.

Results: There were no statistically significant differences for any of the measures.

Conclusions: This particular energy drink at the dose provided does not affect sustained attention, mood, or hand steadiness.

Key Words: vigor, attention, reaction time, caffeine

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Introduction

A recent Position Paper by the International Society of Sports Nutrition states that consuming energy drinks 10-60 minutes before exercise can have an ergogenic effect on mental and physical performance [18]. The primary ingredient that produces this benefit is likely caffeine [18]. Caffeine is a stimulant which acts on the adenosine receptors, leading to an increase in the release of neurotransmitters. This leads to improvements in alertness and cognitive performance. Caffeine doses ranging from 0.5-4 mg/kg increase alertness, attention, and performance on the Psychomotor Vigilance Test [7, 16, 25]. Interestingly, not all studies show an ergogenic effect [6, 15]. Goel et al. examined a group of medical students (10 male, 10 female) that participated in a randomized crossover trial in which they consumed Red Bull (2 mg/kg body weight of caffeine) versus a noncaffeinated placebo drink [15]. The energy drink and placebo improved reaction time with no differences between the groups [15]. Campbell et al. tested a similar energy drink (Redline Power Rush; 2.4 mg caffeine/kg body mass) [6]. Thirty minutes post-ingestion, they found no differences between the energy drink and placebo groups for the vertical jump, bench press, and repeated sprint speed. On the other hand, other investigations have shown a positive effect on various measures of performance [2, 8, 13]. Higher doses of caffeine may lead to unpleasant effects, such as increases in anxiety or agitation. These unpleasant effects are thought to be more prevalent in caffeine naïve or caffeine-sensitive users [29]. Several studies on these products suggest that consuming these types of ergogenic aids may increase power, force production, anaerobic production, muscular endurance, and endurance performance in athletes [19]. NCAA runners have an 84% chance of increasing time to fatigue during sustained running at lactate threshold; these athletes in particular, may also show the ability to tolerate a greater load of circulating lactate prior to reaching exhaustion [14]. Cyclists who consumed an energy drink before cycling improved performance during 1-hour timed cycling trials [17]. Antonio et al. discovered that an energy drink with a relatively high caffeine content (~4 mg/kg body mass of caffeine) improved reaction time as assessed by the psychomotor vigilance test [4]. Energy drinks with significant doses of caffeine have been shown to improve fatigue and focus, and increase energy expenditure in several studies [1, 3, 9, 10, 24]. In athletically trained females, acute MIPS ingestion improved the perception of focus [24]. The acute consumption of energy drinks significantly improved psychomotor vigilance performance, perceived vigor, and perceived fatigue, which affect sustained attention tasks [10]. Acute consumption of energy drinks produced significant improvements in sustained-attention and reaction-timed tasks [9]. Alford et al.

observed improvements in choice reaction time, memory, concentration, and overall subjective alertness after consuming a Red Bull energy drink versus a placebo [1].

Furthermore, an energy drink containing caffeine plus sugar improved memory better than an energy drink with caffeine only [28]. Supplement companies formulate energy drinks intended to increase energy, enhance mood, and boost performance. Consumers are tasked with navigating the multitude of beverage claims. More research is needed to examine the efficacy of energy drinks and clarify why there are discrepancies in the reported effects. Therefore, the purpose of this investigation was to determine the effects of a novel energy drink on indices of mental performance.

Scientific Methods

Participants

Thirty exercise-trained men (n=10) and women (n=20) volunteered for this randomized, counterbalanced, crossover trial. A “trained” individual was defined as someone who regularly exercised at least three times per week (i.e., aerobic training, resistance training, etc.) for the past year. One male subject did not finish (i.e., did not report to the clinical testing site with no reason provided); thus, 29 subjects completed the investigation. By the Helsinki Declaration, the Institutional Review Board for the university approved all procedures involving human subjects (IRB# IRB000OC22JC124 through Keiser University). Written informed consent was obtained from all participants before participation. Exercise history and caffeine consumption were assessed through a questionnaire. Participants estimated their daily caffeine consumption and exercise history by reporting average weekly resistance training and aerobic training duration, other forms of exercise, and how many years they have been training. All participants were asked to abstain from caffeine consumption on the morning of their testing dates. All testing was performed in the afternoon. All participants were asked to refrain from eating, drinking, or exercising for three hours before arrival. Upon arrival at the laboratory, participants were randomly assigned to consume an energy drink (95 mg caffeine) or not consume a beverage. After 30 minutes, participants completed a battery of tests (POMS, PVT, and Hand Steadiness). We had both groups wait, whether they were treatment or control, so conditions were identical for each visit. Participants visited the lab on two occasions. Body composition was only assessed on the first visit.

Supplement Facts
Serving Size 1 Can (355 mL)

Amount Per Serving		%DV
Calories	10	
Total Carbohydrate	0 g	0% †
Total Sugars	0 g	ǂ
Vitamin B6 (as Pyridoxine Hydrochloride)	0.5 mg	29%
Vitamin B12 (as Cyanocobalamin)	100 mcg	4,167%
Choline (as Choline Bitartrate)	100 mg	18%
Magnesium (as Magnesium Citrate)	50 mg	12%
Sodium (as Sodium Chloride & Sodium Gluconate)	95 mg	4%
Potassium (as Potassium Citrate)	50 mg	1%
Acetyl L-Carnitine	500 mg	ǂ
Caffeine	95 mg	ǂ
Alpha-GPC	100 mg	ǂ
Theobromine	100 mg	ǂ
L-Theanine	95 mg	ǂ
Bacopa Monnieri (whole Herb Extract)	50 mg	ǂ

• † Percent Daily Value (DV) based on a 2,000 calorie diet • ǂ Daily Value not established

Ingredients: Filtered Carbonated Water, Natural Flavors, Malic Acid, Monk Fruit Extract, Fermented Sugar Cane (Reb-M)

* THESE STATEMENTS HAVE NOT BEEN EVALUATED BY THE FOOD AND DRUG ADMINISTRATION. THIS PRODUCT IS NOT INTENDED TO DIAGNOSE, TREAT, CURE OR PREVENT DISEASE.

Warning: Consult your physician if you are pregnant, nursing, have a medical condition, or are taking any medication. Keep out of reach of children.

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Figure 1. Supplement Facts panel of the energy drink (JOCKO GO).

Protocol

Body Composition

A multi-frequency bioelectrical impedance assessment device (InBody 270) was used to assess body composition (body mass, fat mass, lean body mass, body fat percentage, and total body water in liters). Participants were instructed to arrive fasted for at least three hours. The participants stood on the platform of the device with bare feet on the electrodes and were then instructed by the device to grasp the handles (which contain additional electrodes on the thumb and fingers) while maintaining straight arms and their arms horizontally abducted approximately 30

degrees. This assessment takes ~1 minute. Only baseline body composition was assessed for this study.

Profile of Mood States (POMS)

The POMS is a 65-word validated psychological test and questionnaire that consists of six mood scales developed for clinical use [8]. The test listed words such as “angry,” “tense,” “lively,” etc., and next to each word is a drop-down menu with the words “how I have felt” above them. The options in the drop-down menu were “not at all,” “a little,” “moderately,” “quite a bit,” and “extremely.” This test scores total mood disturbance, anger, depression, fatigue, tension, and vigor.

Psychomotor Vigilance Test (PVT)

A PVT was administered using Apple iPads via automated testing software (Vigilance Buddy by Research Buddies). The PVT test displays a stimulus (i.e., a number on the screen). As soon as the research participants saw the number appear in the middle of the screen, they touched the screen as fast as possible. Each research participant was given instructions on how the test works and how to do the test correctly. The subjects are instructed to respond as fast as possible to the stimulus while not responding prematurely (i.e., a false start) [9]. The iPads lie flat on a table, we have a marked spot where they are to hold their finger, and we instruct them to touch the screen where the number appears. The PVT assesses vigilant attention and activates the visual, motor, and prefrontal cortex [10].

Hand Steadiness Test

This instrument assesses the ability of a research participant to keep a steady hand while inserting a stylus with a diameter of 0.0625 inches (1.5875 millimeters) into a hole that is 0.109 inches (2.7686) in diameter (Lafayette Instrument, https://lafayetteevaluation.com/products/hole-type-steadiness). Each subject was instructed to insert the stylus into the hole while avoiding contact with the edges of the hole. The stylus was kept in the hole for a duration of 30 seconds. The research participant was instructed to keep the stylus as still as possible without touching the hole’s edge. The number of times the stylus touched the sides of the hole, as well as the total duration of contact time, was determined. This measure was used to assess if the energy drink affected the steadiness of one’s hand while performing a task that required steadiness (i.e., minimal movement).

Statistical Analysis

All statistical analyses were performed on GraphPad (Prism 6) statistical software. All the data for this study were presented as the mean ± SD. Paired t-test were performed to determine whether statistically significant differences ($p < 0.05$) occurred between the treatment and the placebo (i.e., for PVT, Hand Steadiness Test); Wilcoxon matched-pairs signed rank test were performed to determine if differences existed for the POMS. Participants were listed as separate groups statistically based on the protocols they were assigned on the day of that visit.

Results

The characteristics of the research participants are described in Table 1.

Table 1. Characteristics of the Research Participants

Age years	22±5
Height cm	168±8
Weight kg	68.2±12.8
Lean Body Mass kg	51.9±15.0
Fat Mass kg	15.4±6.8
Percent Body Fat	22.6±8.9
Total Body Water liters	38.6±8.6
Total number of years of training	8.9±5.5
Average hours of aerobic training per week	3.7±3.6
Average hours of resistance training per week	5.6±3.7
Other exercise hours per week	2.2±3.9
Average caffeine consumed daily	185±124

All data is presented as the mean ± standard deviation.

N=29 (n=9 male, n=20 female).

Legend: cm – centimeters, kg – kilograms

Profile of Mood States

There were no differences for any of the assessments regarding mood (Table 2 and Figures 2, 3, and 4).

Table 2. Profile of Mood States

	Control	Energy Drink	*p value*
TMDS	22±26	15±19	0.1694
Anger	5±7	4±4	0.2669
Confusion	7±6	6±4	0.3601
Depression	6±8	4±6	0.1930
Fatigue	7±6	6±5	0.3330
Tension	9±6	10±5	0.2568
Vigor	13±6	15±5	0.1413

All data is presented as the mean ± standard deviation.

There were no significant differences between groups.

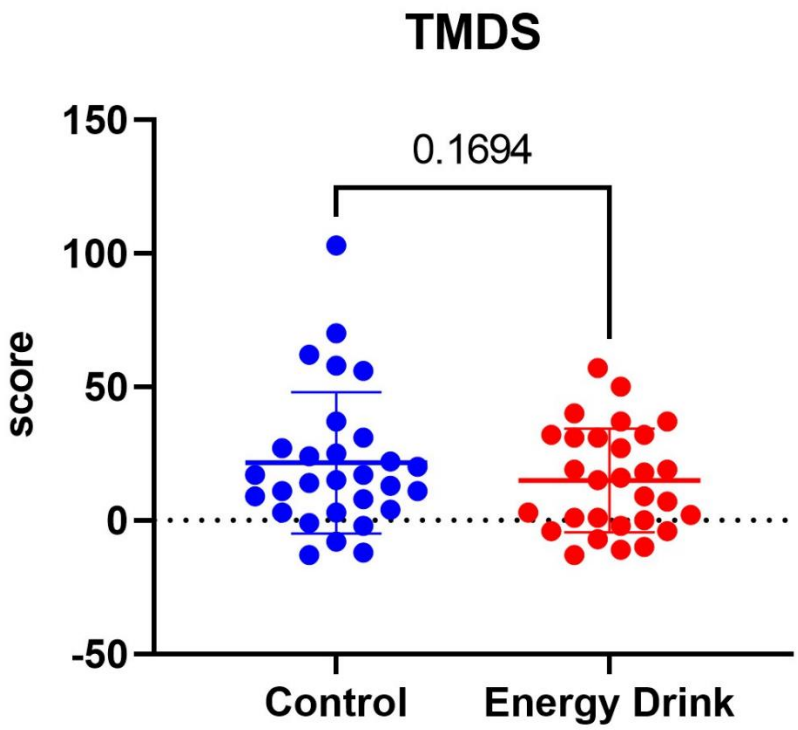

Figure 2. Total Mood Disturbance Score

Each circle represents individual data points. The longer middle line is the mean, whereas the shorter lines above and below the mean represent the standard deviation.

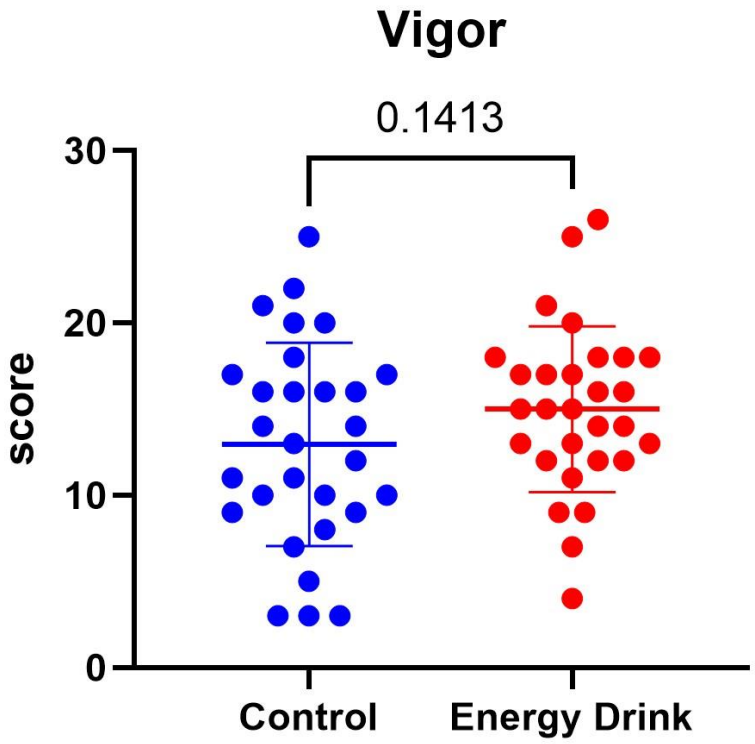

Figure 3. Vigor

Each circle represents individual data points. The longer middle line is the mean, whereas the shorter lines above and below the mean represent the standard deviation.

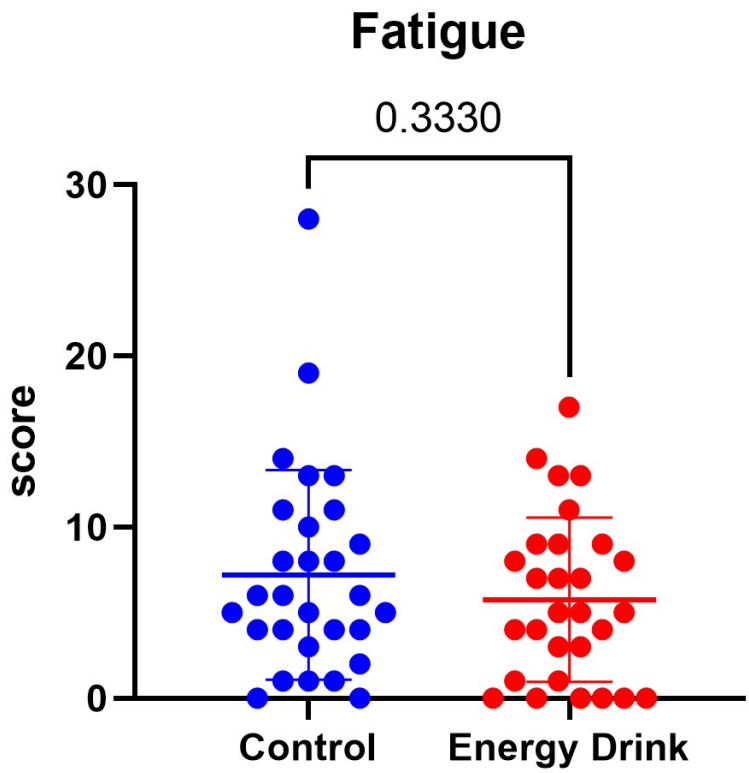

Figure 4. Fatigue

Each circle represents individual data points. The longer middle line is the mean, whereas the shorter lines above and below the mean represent the standard deviation.

Performance

Regarding the performance assessments, there were no differences between groups for reaction time and false starts (via the PVT). Nor were there any differences in the hole steadiness test (Table 3 and Figures 5, 6, 7, and 8).

Table 3. Performance

	Control	Energy Drink	*p value*
PVT – reaction time	296±29	295±26	0.8596
PVT – false starts	3±3	3±2	0.1821
Hand Steadiness – number of touches	8±8	9±9	0.5030
Hand Steadiness – total contact time (sec)	1.07±1.36	1.25±1.71	0.6341

All data is presented as the mean ± standard deviation.

Legend: PVT – psychomotor vigilance test; sec - seconds

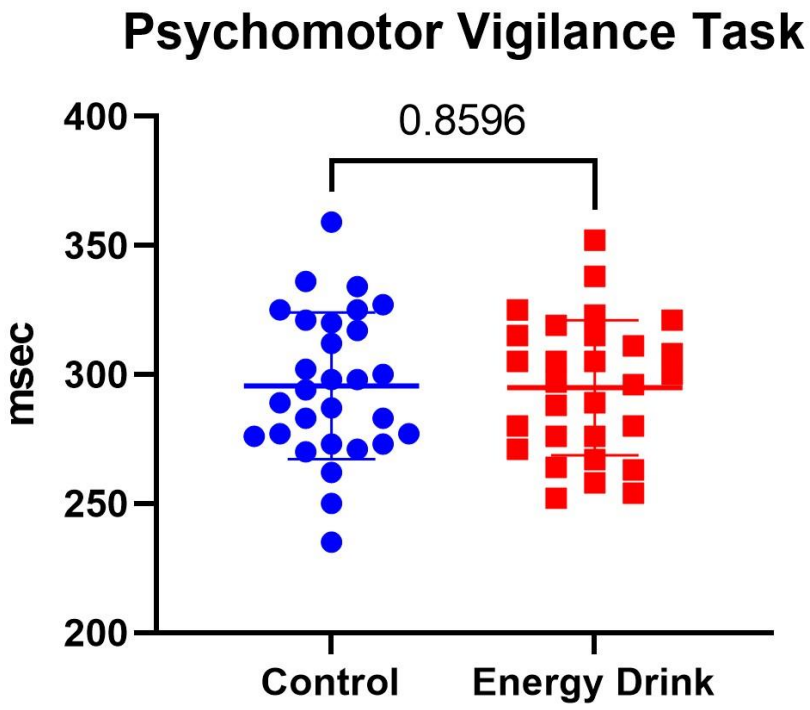

Figure 5. Psychomotor vigilance

Each circle or square represents individual data points. The longer middle line is the mean, whereas the shorter lines above and below the mean represent the standard deviation.

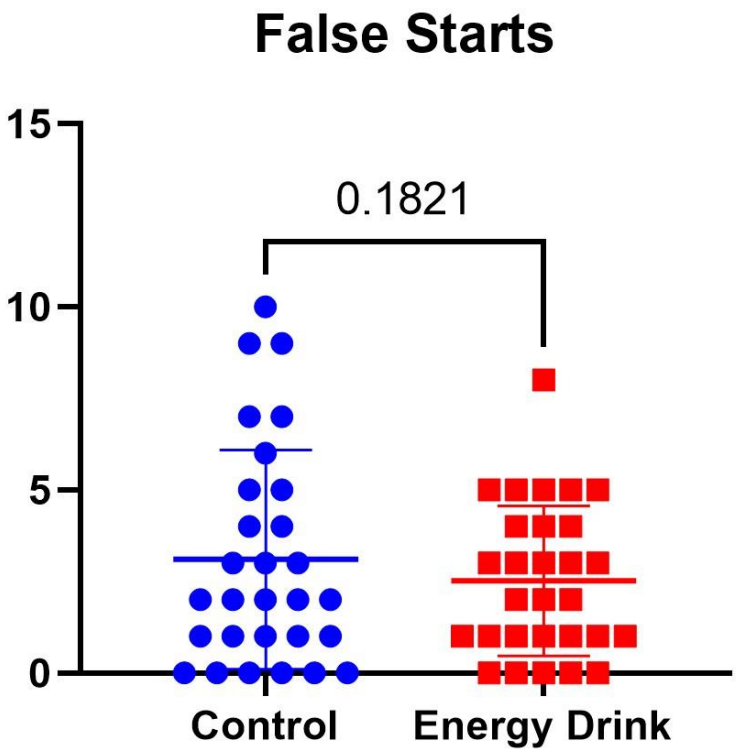

Figure 6. False Starts

Each circle or square represents individual data points. The longer middle line is the mean, whereas the shorter lines above and below the mean represent the standard deviation.

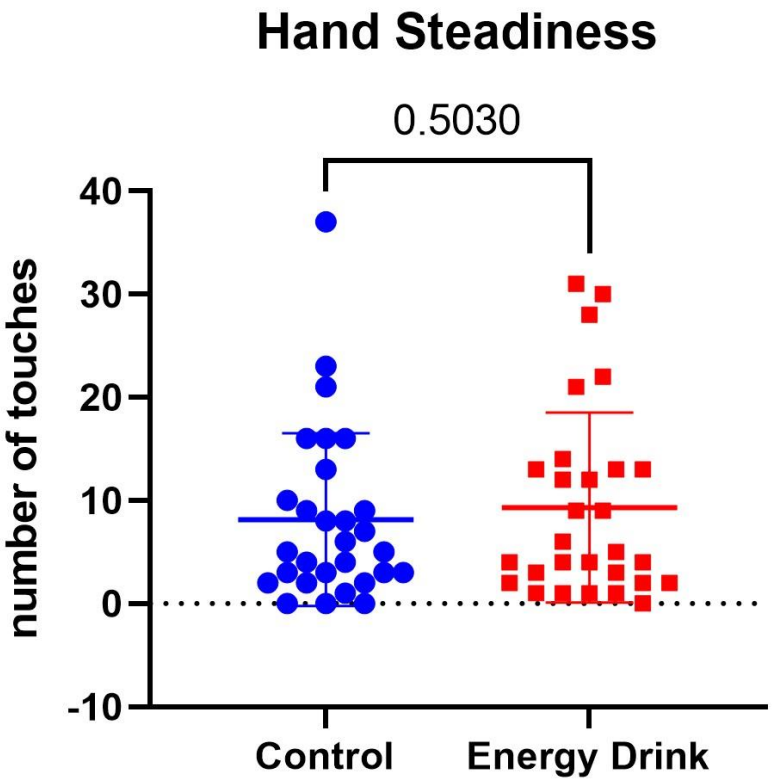

Figure 7. Number of contacts

Each circle or square represents individual data points. The longer middle line is the mean, whereas the shorter lines above and below the mean represent the standard deviation.

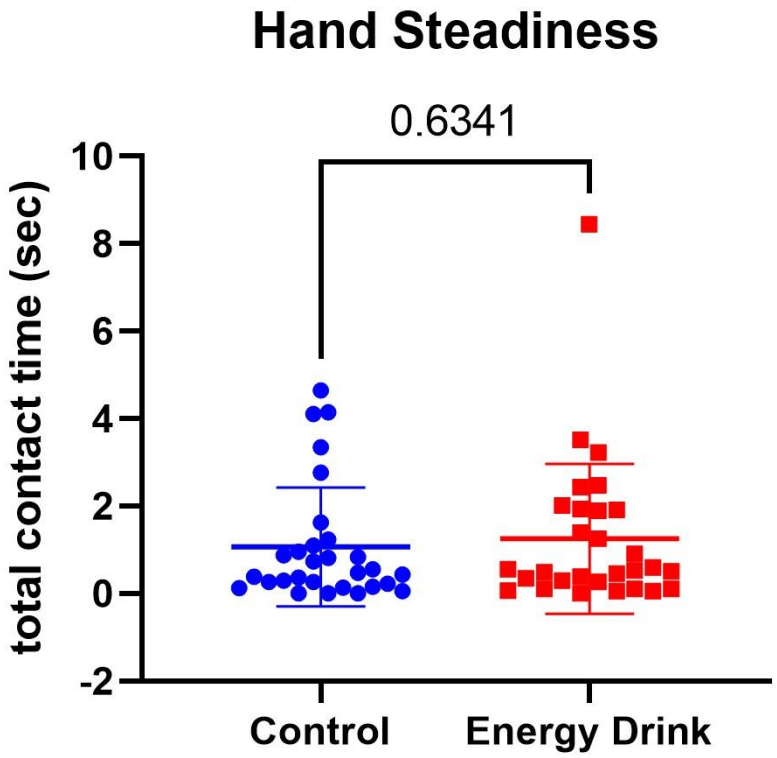

Figure 8. Total time of contact

Each circle or square represents individual data points. The longer middle line is the mean, whereas the shorter lines above and below the mean represent the standard deviation.

Discussion

This study investigated the acute effect of a novel non-caloric caffeine-containing energy drink on mood, sustained attention, and hand steadiness. The major findings of the current investigation are that this particular energy drink (containing approximately 1.4 mg caffeine/kg body mass) did not promote an ergogenic effect.

We posit that the primary differences vis a vis certain energy drinks having an ergogenic effect (or not at all) are related to the dose of caffeine used. The Position Stand by the International Society of Sports Nutrition highlights that a minimal dose of caffeine needed is at least 3 mg /kg body mass consumed 10-60

minutes before a mental or physical task [18]. When participants consumed a Red Bull energy drink versus the equivalent dose of caffeine (3 mg caffeine/ kg body mass), they found no differences in the ergogenic benefits as determined by time-trial performance [23].

Campbell et al. used a dose of 2.4 mg caffeine/kg body mass and discovered that it did not affect the vertical jump, bench press, and repeated sprint speed [6]. Kammerer et al. found no difference between a placebo and an energy drink (Red Bull – 80 mg caffeine, 1000 mg taurine) on time to exhaustion, handgrip strength, and vertical jump [20]. The caffeine dose used by Kammerer et al. was approximately 1.2 mg / kg body mass [20]. Conversely, several investigations have shown an ergogenic effect of energy drinks. Exercise-trained men and women had a faster reaction time as assessed by the psychomotor vigilance task after consuming an energy drink with a relatively high dose of caffeine (4.0 mg caffeine/kg body mass) [2] and faster Pattern Comparison Processing Speed after consuming an energy drink (4.3 mg caffeine/kg body mass).

The current investigation found no effect of the energy drink on indices of mood (i.e., Profile of Mood States questionnaire) or sustained vigilance as assessed by the PVT. This contrasts with other studies [8, 20, 28]. Schwager et al. found that an energy drink improved indices of fatigue, vigor, and total mood disturbance [26]. Conversely, Chtourou et al. found that an energy drink that contained 80 mg of caffeine and 27 grams of carbohydrate improved indices of mood (i.e., depression, confusion, fatigue, anger, etc.) as well as reaction time. However, the Chtourou differed substantially from the current investigation in that they used non-caffeine users, and the energy drink also contained carbohydrate [8]. For instance, Martinez-Olcina et al. discovered that carbohydrate ingestion positively affected mood [22]. In addition, we posit that caffeine naïve individuals might respond positively to a relatively low dose of caffeine compared to regular caffeine users. For instance, Dodd et al. showed that caffeine naïve individuals responded differently to an incremental exercise test compared to regular caffeine users [11].

It should be noted that the current investigation found that the energy drink did not affect hand steadiness (i.e., the “jitters”). We believe this is the first investigation to examine the effect of an energy drink on one’s ability to maintain hand steadiness. It is unknown if a larger dose of this energy drink or caffeine, in general, would change hand steadiness. Nor is it known if there is a difference between individuals who consume caffeine regularly versus those that are caffeine naïve. We asked them to report their daily consumption, but we did not see any statistical reasons to include that in the final data we presented in this article. Future research should examine this phenomenon.

The energy drink in the current investigation did contain other ingredients (i.e., acetyl-l-carnitine, alpha-GPC, theobromine, L-theanine, Bacopa Monnieri) besides caffeine that purportedly improve indices of mental and/or physical performance. However, it is evident that the doses used in the energy drink are insufficient to produce the desired effect. An energy drink with more potent doses of all or individual ingredients (caffeine, acetyl-l-carnitine, alpha-GPC, theobromine, L-theanine, and/or Bacopa Monnieri may produce more favorable results in mood states and attention. It is also possible that higher doses of caffeine with any other higher doses of the other ingredients may produce unfavorable hand steadiness (the jitters).

Perhaps most surprising about the results of this investigation was that each subject knew they were consuming an energy drink (i.e., it was not blinded, we were unable to find a suitable alternative to serve as a control for this study). The control group consumed nothing. Therefore, one might expect at least a "placebo" effect from consuming the energy drink. There were no significant differences between male and female subjects. As previously mentioned, this product is a low dose of caffeine; higher doses of caffeine elicit better results. Thus, we may have seen different results if we used a product that had at least 3 mg of caffeine/ kg of body weight. Beedie et al. had well-trained male cyclists participate in a trial in which they were told they were consuming different amounts of caffeine before a 10-kilometer trial trial [5]. However, unbeknownst to the cyclists, a placebo was administered in all conditions. Interestingly, cyclists performed better in a "dose-dependent" manner (i.e., when they were told that the dose was higher, they performed better). Furthermore, all subjects reported caffeine-related symptoms. Conversely, the current investigation did not show even a minor placebo effect.

Conclusions

This particular energy drink did not affect mood states or measures of sustained attention. Moreover, it did not affect hand steadiness (i.e., the "jitters") as assessed by the Hole Type Steadiness Tester. More research is needed regarding this particular energy drink. We speculate that the primary reason for the null findings was the drink was underdosed.

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