Sports Science Report: Ergogenic Aids On Sporting Performance

Introduction

Many athletes use caffeine as an ergogenic aid to increase performance. There has been lots of research for Caffeine as the ergogenic aid for endurance athlete and the consensus is that it is effective, however, when applied to strength, power and anaerobic activities there seems to be some mixed findings, resulting in inconclusive opinions (1). Caffeine is a substance that accelerates the central nervous system (CNS). It has the effect of reducing the perception of fatigue in individuals. It is one of the most widely used drugs in the world, found in many beverages like coffee, tea, and 'energy drinks' (2). Due to its stimulation, it can improve alertness, concentration, reaction time, and energy level.

Physical exercise intense enough to cause lactate to form is called anaerobic exercise. It is used in non-endurance sports. High intensity, short-duration exercises lasting three seconds to a maximum of two minutes are referred to as anaerobic performances. These exercises focus on speed and power. Adenosine triphosphate and phosphocreatine (ATP-PC) is the primary system used during these exercises. ATP-PC utilises anaerobic glycolysis and muscle stores which produces ATP and results in lactic acid (3).

It is hypothesised that ingesting caffeine will increase the average peak power of the wind gates.

Wind gates are a stationary cycle test of anaerobic leg power (4). The wind gate Anaerobic experiment is arguably one of the most known labs fitness tests. It is usually performed on a stationary bike with ergometry and is mainly used to determine the individual’s anaerobic ability and anaerobic state outputs. It requires the participant to cycle in a maximum effort for 30 seconds. After the participant cycles, the 30-sec spurts a few measurements will be taken to see how hard the participant worked. Those are RPE and blood lactate.

To help understand how hard an exercise test or sport is the Borg rating of perceived exertion scale (RPE scale), is a frequently used to give a quantitative measure/score.

The scale is used in a variety of setting from sports coaches during training and competitions to doctor using it to see the patient’s exertion during a test. Exercise intensity is rated on a scale of 6-20; 20 being equivalent to maximum effort and six being equivalent to complete rest.

The by-product of anaerobic glycolysis, lactate, has traditionally been thought to be detrimental to muscle function (5). However, this appears likely only when the lactate level is very high. Elevated lactate levels are only one of many changes that occur during intense exercise that can lead to fatigue. Fatigue, that is muscle failure. Physical exertion or fatigue can lead to elevated muscle and blood lactate concentrations. Lactic acid occurs in the blood when glycogen is broken down in muscle and can be converted back to glycogen in the liver (6).

The purpose of this study was to test the effect of 3-mg·kg -1 body mass of caffeine on average peak power and RPE.

Method

One participant volunteered to participate in this experiment. They were weighed before exercise testing; they were a 21-year-old female that weighed 58kg and had a low level of fitness. 3mg/kg of body mass was used when consuming caffeine. Decaffeinated coffee was consumed as a placebo. Sixty minutes before exercise testing either the coffee or placebo were consumed, varying on two separate occasions and weeks. The subject performed four, thirty-second wind gates on a stationary bike with a five-minute active rest in between each wind gate. Heart Rate, Blood Pressure, Blood lactate and RPE were recorded after each wind gate as well as average max power, peak power, and fatigue index (7).

Results

There was no significant difference between caffeine supplementation and placebo on average peak power (figure 1).

Table 1 shows the physiological effects the wind gates had. There was no significant difference between the two trials when comparing the physiological data. While the first sprints power average with caffeine was slightly higher, the rest of the results are the same. No significant difference was found between heart rate, and blood pressure either.

A slightly higher RPE was found with caffeine supplementation, as compared to the placebo trial as well as Blood lactate, but nothing significant enough that can state that caffeine greatly affected it.

The only out layer in the data is the first wind gate for the placebo. The participant reached a power peak of 1181 (table 1). This can be explained because it was the very first sprint in the experiment, so the participant didn’t know the difficulty of the experiment ahead and went as hard as they could.

Discussion

The purpose of this study was to test the effect of 3-mg·kg -1 body mass of caffeine on multiple sprints cycle performance in a female participant. This study found that caffeine ingestion produced no significant improvement in the sprints as compared to the non-caffeine sprints. Consequently, the hypothesis that caffeine ingestion would significantly increase the average peak power was not supported.

There is conflicting evidence of caffeine’s ergogenic effect when it comes to power-based sports that need short, anaerobic bursts of activity. An increasing number of studies have been published involving HIIT training, resistance training, and force-production activity.

Improvements were observed, in a different study, in absolute strength and peak power (Wingate test) when 5 and 7mg/kg body mass, was consumed. Few studies exist on the effect of low-dose supplementation (6). One study by Lorino, Lloyd, Crixell, and Walker (2006) examined caffeine’s effect on agility performance in the Pro agility run and 30-second Wingate test. Sixteen recreationally active males received a dose of 3mg/kg of body weight an hour before testing (8). Researchers based the dosage on the midpoint of the commonly tested range of 3-9mg/kg body weight (8). There was no significant change in peak power, mean power, per cent power decrease, and pro agility performance (8). The study concluded that caffeine ingested at this dosage did not enhance performance in recreationally active males, but that the results could not be extrapolated to anaerobically trained athletes (8) (3).

The lack of statistical significance on all Wingate's may have been due to the small sample size. This study only had one participant conducting the test. The participant was also not an anaerobic athlete. More trends could be seen if a larger group of people, who were anaerobic athletes, participated.

Hoffman and colleagues conducted comparable research and had similar findings (9). Caffeine did not increase any of the power performance measures when compared to the placebo, decaffeinated drink.

Earlier research examining the effects of caffeine on performance typically employed untrained subjects with methodologies not specific to high-intensity intermittent sports activities (10). These designs and subject characteristics potentially contributed to the conclusion that caffeine may not be beneficial in this model. However, recent studies have started employing trained subjects accustomed to the intensity of the protocols tested. Therefore, caffeine seems to be the most beneficial for trained subjects, with most studies showing little to no effect on untrained subjects. Its still unclear as to why there is a difference in training status between participants.

Practical Application

The results of this study suggest that consuming caffeine sixty minutes before anaerobic activity does not improve high-intensity exercise performance.

Future research should examine the impact and the extent caffeine has on high-intensity performance, with individual and group data being assessed, with athletes that are anaerobically trained. Studies are also needed to understand whether individuals respond similarly during repeated bouts of exercise (true responders) with caffeine consumption and elucidate the underlying mechanisms between responders and non-responders.

Finally, pinpointing what precise mechanisms caffeine effects as an ergogenic aid is needed.

Admittedly, one co-founder of caffeine research is the dynamic variability in methodology making it problematic to compare findings to identify a definitive, global answer regarding caffeine's potential impact on exercise bouts dominated by anaerobic metabolic ATP production. Therefore, research should continue to focus on the responder vs. non-responder concept in attempts to identify the parameters that create a responder to caffeine's ergogenic properties.

Individual testing will be needed to see if caffeine before and/or during training and competitions is ergogenic to that person as caffeine response and amount varies.

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