Hypothesis

Point: Caffeine improves endurance sports performance.
Counterpoint: Caffeine does not improve endurance sports performance.

Clinical and Non-Clinical Use

In a clinical setting, caffeine has been shown to be effective as a treatment for premature babies with apnea by improving lung function (6). Caffeine, in combination with acetaminophen, is also effective in treating migraine headaches, and alleviating nausea and functional disability (7). Non-clinically, people regularly ingest caffeine via coffee and soda in order to improve their attentional processes (8).

RDA and Safe Consumption Levels

There is no Recommended Dietary Allowance (RDA) for caffeine; however doses over 600 mg often result in overdose (8). Overdose is associated with restlessness, anxiety, and irritability (8). Recommended caffeine intake levels that are not associated with adverse side effects are 400–450mg/day for healthy adults (5).

Mechanism of action

The most widely accepted mechanism is caffeine’s ability to reversibly inhibit adenosine which is an antagonistic neurotransmitter to many excitatory neurotransmitters particularly dopamine (2). Caffeine is very similar in structure to adenosine and competes with adenosine when binding to A1 and A2 receptors in the brain (2). Consequently, caffeine leads to delayed fatigue, improved coordination, increased locomotor activity, and improved alertness/reaction time (9,2). Furthermore, caffeine increases plasma levels of catecholamines which act to improve endurance exercise performance by increasing cardiac output and serum FFA via lipolysis, which spares muscle glycogen (2).

Evidence to support the Ergogenic effects of caffeine

A randomized, placebo controlled, double blinded study that investigated the effects of caffeine on cycling endurance and found that low dose caffeine (*3 mg*kg\(^{-1}\) body mass) was able to significantly improve endurance performance on a 60 minute, 75% peak power output cycling time-trial (3). Caffeine was also found to significantly increase heart rates, indicating enhanced CNS stimulation. Participants were given the same standardized meal and hydration plan 24 hours leading up to the trial, negating the possibility of different pre-competition meals and hydration status confounding the results.

Another randomized, placebo controlled, double blinded study investigated the effects of caffeine ingestion on performance time, mean speed and mean and peak power during a 1 km cycling time-trial, and found that caffeine consumption (5mg/kg) significantly improved results in all measures (10). A well trained population accustomed to exercise of this intensity was used in this study, negating the possibility that the results were due to high levels of performance.
variance which is typically observed in recreationally active populations. These results support the notion that caffeine not only helps with aerobic endurance activities, but also with short-duration high intensity endurance exercise.

**Evidence to refute the counterpoint**

A study that measured the effects of caffeine on a 100km cycling time-trial that included high intensity epochs (HIE) found that caffeine in a 7% CHO solution did not significantly improve performance relative to individuals who only received a 7% CHO solution as well individual in the placebo group (4). Though the results were promising, the researchers overlooked 3 important details. Firstly, the highest levels of dehydration (3.5% body mass) were present in the caffeine group and dehydration is known to impair physical work capacity and proper physiological function. Secondly, heart rates were significantly elevated in the caffeine group indicating increased CNS stimulation despite no significant increase in power output. Lastly, only 8 of the 15 subjects completed the experiment because it was too difficult which decreases the internal validity of the experiment (which was single blinded which introduces the possibility of experimenter biasing effects.) Taken together, these factors provide reasons as to why caffeine did not improve performance to levels of statistical significance.

There has also been evidence indicating that chronic ingestion of caffeine will negate previously found ergogenic effects due to tolerance effects (1). Specifically, subjects who consumed 3mg/kg of caffeine daily for 28 days performed similarly to their pre-caffeine baseline on a 60 minute, 60% Vo2 max cycling time trial after 28 days; despite having previously displayed improved initial performance This is alarming considering numerous individuals consume daily doses of caffeine (1). There are however, important factors to consider. Firstly, the researchers used a sample of recreationally active individuals who are known to produce highly variable performances on fitness tests, suggesting that the decreased ergogenic effect observed after 28 days may simply be attributable to variance. Secondly, self report measures (which are prone to response biases) were used to ensure that individuals were ingesting only the prescribed caffeine dose; introducing the possibility that the tolerance effects were due to chronic ingestion of higher doses of caffeine.

**Conclusion**

Caffeine improves endurance sports performance.
References:


Point: Caffeine
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