**PDHPE LITERATURE REVIEW**

**The use of ergogenic aids in improving performance:**

Ergogenic aids are classified as *“Substances with the potential to improve performance, especially resistance to fatigue”* (Anderson, 2013). In regards to improving performance, ergogenic aids are used widely by both recreational and elite athletes of all different sports and exercises, with all ergogenic substances varying in form and effectiveness. One particular ergogenic aid that is used widely among athletes is the stimulant Caffeine.

McDaniel (2009) suggested that caffeine exerts effects on an athletes speed and power output, along with assisting an athlete in endurance and the resistance of fatigue. Due to its versatility, caffeine is the most common drug used to improve sporting performance, with up to 25% of athletes aged between 11 and18 using caffeine to enhance their performances (McDaniel, 2009). In disagreement, Hush (2007) indicated that Caffeine *“is unsuitable for growing children or adolescents”* as an excessive consumption may lead to adverse side effects like elevated blood glucose, tachycardia and agitation.

A major factor of performance that caffeine affects is that of endurance. In a review titled ‘International Society of Sports Nutrition Position Stand: Caffeine and Performance’ it is stated that evidently *“Caffeine supplementation provides an ergogenic response for sustained aerobic efforts in moderate-to-highly trained athletes”* (Goldstein et al., 2010). This is because it contributes to physiological and psychological adaptations such as better regulation of acids and fats, and improved concentration (Goldstein et al., 2010). This notion is supported through McDaniel’s (2009) who declares that *“caffeine provides improved endurance due to an increased utilization of fat as fuel and a sparing effect on carbohydrate utilization”*. However, in ‘Caffeine and Exercise Performance’ it is suggested that when caffeine is ingested, it can be difficult to ascertain the individual effects on the central nervous system, muscles and fat tissue due to the way in which caffeine is absorbed throughout the body (Graham et al., 1996). This therefore allows caffeine’s effect on endurance exercise to vary depending on the dose, the athlete and the exercise. Goldstein et al. (2010) furthers this notion through stating that *“Caffeine supplementation can improve sport performance but this is dependent upon various factors including, but not limited to, the condition of the athlete, exercise (i.e. mode, intensity, duration) and dose of caffeine”*. Overall, the general consensus among the literature reviewed is that yes, caffeine does (to varying extents) improve endurance, however this is relative to the dose, athlete and the exercise.

Just like caffeine’s effect on an individual’s endurance capabilities, particularly through the literature reviewed it can be ascertained that caffeine also has a significant impact on an athlete’s level of concentration, arousal and neural capabilities. This is evident through Goldstein et al (2010) stating that *“Because caffeine crosses the membranes of nerve and muscle cells, its effects may be more neural than muscular”*. This notion is furthered through McDaniel et al. (2009) articulating that due to caffeine acting as a stimulant, it arouses the brain, which therefore leads to clearer thinking and increased concentration. Thus, an athlete’s level of productivity and efficiency in performance is improved as they are able to concentrate harder and for longer periods of time. To further this notion, an article titled ‘Is Caffeine a Cognitive Enhancer?’ states caffeine’s *“indirect action on arousal, mood and concentration contributes in large part to its cognitive enhancing properties”* (Nehlig, 2010).

Similarly, caffeine’s influence on an athlete’s performance is in no small part due to the effect it has on an individual’s central nervous system. This is evident in McDaniel et al. (2009) saying that caffeine *“can exert its effects on both the central nervous system and the peripheral tissues, resulting in a number of physiological effects that might improve performance”.* Goldstein et al. (2010) also endorses this through discussing the effects caffeine has on the central nervous system and how these influence mental capabilities such as memory and motor learning, stating that these effects “*may be related to an increased capability to sustain concentration, as opposed to an actual effect on working memory”*. Therefore, through this collective notion, both McDaniel et al. (2009) and Goldstein et al. (2010) successfully articulate that caffeine’s effect on both the central and peripheral nervous systems results in better concentration and mental capabilities; thus improving athletic performance. However, Nehlig (2010) highlights an important aspect in regards to caffeine’s impact on concentration, arousal and mental capabilities through stating that caffeine’s *“effects were rather result of complex interactions with does, subject, and task variables”.* Overall, through the literature reviewed, it can certainly be concluded that caffeine has a substantial impact on an athlete’s performance through the effects it exerts on concentration, arousal and mental capabilities.

Another notion consistent among the literature is that there is a dire need for an athlete to monitor their intake and dosage of caffeine. This is particularly evident through Graham et al. (1996) establishing that one hour prior to exercise, a moderate dose of caffeine should be ingested as it will enhance certain types of exercise (Graham et al, 1996). According to Graham et al. (1996) the moderate dose of caffeine is 3-13 milligrams per kilogram of body weight. However, in a piece of more recent literature ‘Running Science’, Owen Anderson (2013) states that the ergogenic dose of caffeine is 3-9 mg/kg. This in turn suggests inconsistencies among caffeine doses and the effects certain doses can have.

Moreso, an article entitled ‘Caffeine’s Effects on Your Thinking’ not only supports Anderson’s suggestion with regards to the moderate dose of 3-9 mg/kg, but also states that *“More than moderate use does not offer additional benefits, and higher doses sometimes lead to negative effects”* (Hale, 2012). Some of these side effects include: dizziness, insomnia and gastrointestinal distress (Graham et al. 1996). Anderson also highlights the adverse effects that enduring consumption of caffeine can have on an athlete’s health and overall athletic performance. This is evident in saying that chronic caffeine ingestion *“might block the acute, positive effects of caffeine on performance on a specific day”* (Anderson, 2013). This in turn lessens the influence that caffeine has on improving performance; thus making caffeine supplementation somewhat redundant. In regards to the interrelationship between the effects of caffeine on improving performance and moderate dosage, it is considered safe to consume between 3-9mg/kg up to an hour before exercise. Although the effects of caffeine are relative to the athlete, dose and exercise, if these guidelines were to be followed, optimal improvement of performance would be encouraged.

Through the review of several pieces of literature, the broad range of effects caffeine exerts over athletic performance can be identified and discussed, both in support and in contrast of one another. In the study of the use of ergogenic aids, specifically caffeine, it can be accurately identified that caffeine does in fact have an ergogenic effect on the improvement of performance, particularly endurance, concentration and mental capabilities.