The Effects of Caffeine on Repeated Sprint Performance in Team Sport Athletes - A Meta-Analysis -

Stephen J. BROWN\textsuperscript{1} • Julie BROWN\textsuperscript{2} • Andrew FOSKETT\textsuperscript{3}

Equivocal findings exist regarding the ergogenic effects of caffeine in repeat sprint performance in team sports, and there is currently no meta-analysis of available data. Therefore, appropriate studies were obtained from electronic databases following identification using pre-determined search criteria. Extracted data on repeat sprint performance in team sport athletes were entered into a meta-analysis to determine a summary statistic for overall effect. Eight studies provided suitable data for analysis. Pooled data on sprint distances of 15m ($Z=1.81$, $P=0.07$), 18.3m ($Z=0.26$, $P=0.79$), 20m ($Z=0.13$, $P=0.90$), 30m ($Z=1.26$, $P=0.21$), and 36.6m ($Z=0.78$, $P=0.44$) indicated no ergogenic effect attributable to caffeine ingestion. Thus, the current available evidence does not support an ergogenic effect for caffeine in repeat sprint performance in team athletes.

\textit{Keywords:} caffeine, sprint performance, meta-analysis

\textsuperscript{1} School of Health Sciences, University of Ballarat, VIC, Australia
\textsuperscript{2} The Cochrane Review Group, FMHS, University of Auckland, New Zealand
\textsuperscript{3} School of Sport and Exercise, Massey University, Auckland, New Zealand

ISSN: (print) 2066-8732/(online) 2069-7244
© 2013 • National Institute for Sport Research • Bucharest, Romania
Caffeine and Sprint Performance

Introduction

The pervasive use of caffeine as a mild stimulant, as indicated by the habitual consumption of coffee and tea, has provoked interest in its potential ergogenic effects in sports performance. Caffeine appears to have an ergogenic effect for prolonged endurance exercise, where increases in both exercise duration and mean power output have been reported (Doherty & Smith, 2004). There is also evidence to support an ergogenic effect of caffeine for shorter duration high-intensity exercise (Stuart et al. 2005; Paton et al. 2001). With regards to high intensity intermittent activity, the International Society of Sports Nutrition state: “Caffeine supplementation is beneficial for high-intensity exercise, including team sports such as soccer and rugby, both of which are categorised by intermittent activity within a period of prolonged duration (Goldstein et al. 2010). However, relevant evidence which supports the translation of caffeine’s ergogenic effects into performance in sports which require multiple sprints actually remains equivocal.

A number of studies have examined the ergogenic effects of caffeine on repeat sprint performance in team sports. Paton et al. (2001), Foskett et al. (2009), and Woolf et al. (2009) all reported no difference in sprint performance when caffeine ingestion was compared to placebo. Similarly, Astorino et al. (2012) reported no effect of caffeine on sprint times in soccer players. In contrast, caffeine has been reported to improve sprint performance in team sport players following ingestion of anhydrous caffeine (Carr et al. 2008) and a caffeinated beverage (Del Coso et al. 2012) compared to placebo. Furthermore, Gant et al. (2010) and Roberts et al. (2010) reported quicker sprint times following ingestion of a carbohydrate-caffeine solution compared to a carbohydrate only control in soccer players and rugby players respectively.

As repeated periods of high intensity, short duration sprint activity are a consistent feature of many team sports, it is reasonable to further scrutinise these discrepancies in regard to any possible ergogenic effects of caffeine on multiple sprint performance. Therefore, the aim of this meta-analysis was to examine appropriate studies to identify whether current data support, or refute, any ergogenic effect of caffeine ingestion on repeat sprint performance in team sport athletes.

Methods

Three electronic databases were searched form inception to 2012 (Medline, Pub-Med, and Sport Discuss) using the following search terms: caffeine; exercise; soccer; team sports; football; sprint performance. Studies which used non-running sprint modalities (e.g. stationary cycle ergometer sprint tests, and
Wingate cycle sprint tests) were excluded from the analysis. Similarly, only studies which provided an appropriate description of both subject population and type of team sport performed by the subjects’, were included.

The computer programme ‘Rev-Man-5.1’ (Review Manager, 2011) was used for data entry and subsequent analysis. Available data were pooled with an overall test statistic (Z) and probability (P) calculated. Data were independently retrieved from the selected original research papers by two experienced academics (SB and AF), and where necessary, a third person (JB) was used to provide expert opinion.

**Results**

Eight studies provided suitable data for the meta-analysis, covering a range of sprint distances from 15m (16.4 yards) to 36.6m (40 yards), and these are summarised in the Forest plot shown in figure 1. Standard mean difference ranged from +0.27 (where positive favoured placebo) to -0.61 (where negative favoured caffeine). When the test for overall effect was calculated for each sprint distance, Z values ranged from 1.81 (P=0.07) to 0.13 (P=0.90) with no outcome significantly favouring caffeine (all P>0.05).
Caffeine and Sprint Performance

Figure 1. Forest Plot on sprint performance in team sport athletes comparing caffeine ingestion with placebo.

Discussion

This meta-analysis of pooled data from 8 suitable studies does not support any ergogenic effect of caffeine ingestion on repeat sprint performance in team sport athletes. With the limited available data and the equivocal findings of the...
studies comprising this meta-analysis, we are confident that currently there is no convincing argument to support the use of caffeine ingestion in the preparation of team sport athletes for enhancing sprint performance. Clearly there is a need for further research, and controlled, randomized trials with sufficient subject numbers. Drinks containing caffeine are likely to remain ubiquitous in society, and caffeine is now a common additive to ‘sports’ drinks — whilst we do not identify any detrimental effects of caffeine ingestion on sprint performance in team sport athletes, the ergogenic effect on sprint performance of such ingestion is not supported by this meta-analysis. There may be positive effects of caffeine on other measures of performance during team sports (e.g. counter-movement jump height (Foskett et al, 2008; Gant et al 2010)) however these are beyond the scope of this analysis. Caffeine may be gaining popularity as an ergogenic aid in soccer (Pereira et al. 2012), particularly during the higher intensity intermittent interval training which is commonplace in team sports (Ferrari Bravo et al. 2008; Stolen et al. 2005), however there is little evidence to support this strategy.

In the current meta-analysis, we used a pooled standard deviation and a standardized mean difference (SMD) — this is a dimensionless value which includes an adjustment for small sample bias. This has been used in preference to the ‘effect size’ (ES) as used by others (Paton et al. 2001), and is in contrast to Doherty and Smith (2004), where the effectiveness of caffeine ingestion with regard to human exercise performance was calculated using ES. The ES is a dimensionless value centred at zero if caffeine has a neutral effect compared to the placebo, and given by: $ES = \frac{mean_{caffeine} - mean_{placebo}}{SD_{placebo}}$. Thus, if a caffeine trial resulted in a greater value for a dependent variable compared to placebo and this denoted an improved performance (e.g. an increased endurance time), a positive ES would be calculated and subsequently classified according to methods described by Cohen (1977). Although we have chosen a different method to that of Doherty and Smith (2004), we are confident that Rev-Man-5.1, as used by the Cochrane Collaboration, provided a robust statistical tool for our meta-analysis.

Four of the studies (Carr et al. 2008; Del Coso et al. 2012; Gant et al. 2010; Roberts et al. 2010) used in the meta-analysis independently reported significant benefits on sprint performance when caffeine ingestion was compared to a placebo — these findings were not supported when the data were pooled. This is likely due to the small standard mean difference (similar to effect size) calculated for these studies, and relatively small subject numbers. This finding further supports the importance of using multiple studies to inform practice, and we would encourage sports practitioners, coaches, and those involved in training team sport athletes to exercise caution when recommending caffeine as an ergogenic aid.
References


Stephen BROWN BSc (Hons), PhD is a senior lecturer in anatomy and physiology at the University of Ballarat, Victoria, Australia. He has previously held senior positions at Massey University (NZ), and DeMontfort University (UK). Dr Brown’s research interests are human cardio-respiratory physiology and exercise science, and he provides independent scientific support to health care companies. He has authored many manuscripts on human physiology, and is currently a course coordinator in anatomy and physiology for a large undergraduate nursing programme.

Corresponding address:
Stephen J. Brown
School of Health Sciences,
University of Ballarat,
University Drive,
Mount Helen,
VIC 3353,
Australia.
Phone: +61 3 53276258
Fax: +61 3 5327 9478
E-mail: sj.brown@ballarat.edu.au

Julie BROWN, PhD RGN is currently a Senior Research Fellow at the University of Auckland, New Zealand, where she has worked for the last 7 years. She earned her PhD in psychoneuroimmunology from the University of Wolverhampton, UK. She works in the area of research synthesis and translational health covering topics such as menstrual disorders and subfertility, physical activity and health, and gestational diabetes. She is an author on over 24 Cochrane systematic reviews and protocols and has been a lead researcher in the production of national clinical practice guidelines in New Zealand. Julie can be contacted on j.brown@auckland.ac.nz

Andrew FOSKETT, PhD is currently a Senior Lecturer in the School of Sport & Exercise Science at Massey University, Auckland (NZ). Andrew completed his PhD in Exercise Physiology in 2004 at Loughborough University (UK) examining the metabolic demands of high intensity intermittent activity. He has continued his research in this field and has published regularly in exercise science journals in the areas of nutritional intervention and performance during intermittent activity and team sports as well as presenting his research at various National and International Sports Science and Medicine conferences. Andrew can be contacted on a.foskett@massey.ac.nz