Caffeine Enhances Cognitive Function and Skill Performance During Simulated Soccer Activity

Andrew Foskett, Ajmol Ali, and Nicholas Gant

There is little evidence regarding the benefits of caffeine ingestion on cognitive function and skillful actions during sporting performance, especially in sports that are multifaceted in their physiological, skill, and cognitive demands. Purpose: To examine the influence of caffeine on performance during simulated soccer activity. Methods: Twelve male soccer players completed two 90-min soccer-specific intermittent running trials interspersed with tests of soccer skill (LSPT). The trials were separated by 7 days and adhered to a randomized crossover design. On each occasion participants ingested 6 mg/kg body mass (BM) of caffeine (CAF) or a placebo (PLA) in a double-blind fashion 60 min before exercise. Movement time, penalties accrued, and total time were recorded for the LSPT. Physiological and performance markers were measured throughout the protocol. Water (3 ml/kg BM) was ingested every 15 min. Results: Participants accrued significantly less penalty time in the CAF trial (9.7 ± 6.6 s vs. PLA 11.6 ± 7.4 s; \( p = .02 \)), leading to a significantly lower total time in this trial (CAF 51.6 ± 7.7 s vs. PLA 53.9 ± 8.5 s; \( p = .02 \)). This decrease in penalty time was probably attributable to an increased passing accuracy in the CAF trial \( (p = .06) \). Jump height was 2.7% (± 1.1%) higher in the CAF trial (57.1 ± 5.1 cm vs. PLA 55.6 ± 5.1 cm; \( p = .01 \)). Conclusions: Caffeine ingestion before simulated soccer activity improved players’ passing accuracy and jump performance without any detrimental effects on other performance parameters.

Keywords: association football, intermittent shuttle running, LIST, LSPT, ergogenic aids

Caffeine’s potential to enhance endurance performance or exercise capacity has been well documented (see Graham, 2001, and Magkos & Kavouras, 2004, for recent reviews or Doherty & Smith, 2004, for a meta-analysis). There also appears to be sufficient evidence that the ergogenic properties of caffeine extend to shorter duration high-intensity activities (Bruce et al., 2000, Doherty, Smith, Hughes, & Davison, 2004; Jackman, Wendling, Friars, & Graham, 1996). However, the evidence with regard to brief intense exercise of an explosive nature such as
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as a single sprint (Bell, Jacobs, & Ellerington, 2001; Collomp, Ahmaidi, Chatard, Audram, & Prefaut, 1992) or repeated sprints (Greer, McLean, & Graham, 1998; Paton, Hopkins, & Vollebregt, 2001) appears equivocal.

Although physical attributes are important for successful match play, the major difference between elite games players and their recreational counterparts is better cognitive functioning and skillful performance (Williams, 2000). This is evidenced by enhanced selective attention (Fontani, Lodi, Felici, Migliorini, & Corradeschi, 2006; Kioumourtzoglou, Kourtessis, Michalopolou, & Derri, 1998), as well as the ability to better recognize (Williams, Hodges, North, & Barton, 2006), and perform, skillful actions (Reilly, Williams, Nevill, & Franks, 2000). During soccer, most goals are scored in the latter stages of match play (Jinshen, Xioke, Yamonakak, & Matsumotot, 1991) and reflect fatigue-associated lapses by the other team in concentration, decision making, and skill performance (Reilly, 1996). Therefore, the beneficial properties of caffeine supplementation for team-sport athletes may not be to increase endurance performance per se but rather to attenuate any fatigue-related decrements in skillful performance, concentration, or cognitive function.

There have been numerous studies reporting enhanced cognitive functioning after caffeine ingestion. Many studies report increased arousal and vigilance in occupational situations including military personnel (Gillingham, Keefe, & Tikuisis, 2004; Lohi et al., 2007; McLellan, Kamimori, Bell, et al., 2005; McLellan, Kamimori, Voss, et al., 2005; Tikuisis, Keefe, McLellan, & Kamimori, 2004) and drivers (Brice & Smith, 2001) after caffeine ingestion. There is also evidence that caffeine ingestion improves visual information processing and reaction time during computer-based or pen-and-paper tests (Brice & Smith, 2001; Haskell, Kennedy, Wesnes, & Scholey, 2005; van Duinen, Lorist, & Zijdewind, 2005). Furthermore, Marsden and Leach (2000) reported improved performance after caffeine ingestion in some aspects of maritime navigational skill (visual search) but not in others (chart search or problem solving).

There is, however, minimal information regarding the effect of caffeine on actual sporting-skill performance. Stuart, Hopkins, Cook, and Cairns (2005) are the only authors to report enhanced skill performance after caffeine ingestion (6 mg/kg body mass [BM]), namely, increased passing accuracy during a protocol that simulated the demands of rugby match play. However, in that study the performance measured was a closed skill (one performed in a stable or largely predictable environment, self-paced), rather than the open skills (motor skills performed in an unpredictable, changing environment, which dictates how and when the skill is performed, externally paced) typical of team-sport match play (Knapp, 1974).

Many of the studies using open skills relate to simulated occupational tasks in warfare or driving or flying environments. In these situations caffeine ingestion reportedly improves marksmanship (McLellan, Kamimori, Bell, et al., 2005), target detection, and engagement speed during urban warfare simulation (Gillingham et al., 2004) and improves simulated driving performance (Brice & Smith, 2001). However, these studies failed to show any improvements in more complex processing tasks (e.g., friend–foe discrimination) that might be integral to skillful sporting performance. Similarly, some studies have failed to show any improvements in marksmanship (McLellan, Kamimori, Voss, et al., 2005; Tikuisis et al.,
2004) or flight simulation performance (Lohi et al., 2007) after caffeine ingestion. Lohi et al. reported overconfidence in flying performance after caffeine supplementation, suggesting a potential negative consequence of caffeine ingestion. Another reported negative effect of caffeine ingestion is hand tremor (Shirlow & Mathers, 1985), and evidence suggests that there are potentially deleterious effects of caffeine on skill performance during microsurgery (Urso-Baiarda, Shurey, & Grobbelaar, 2007). In their recommendations for dietary supplements for soccer players, Hespel, Maughan, and Greenhaff (2006) highlight the beneficial effects of small doses of caffeine (1–2 mg/kg BM) on reaction time, alertness, and visual information processing but warn that doses higher than this might negatively affect mental functioning through overarousal.

Despite the removal of caffeine from the World Anti-Doping Agency’s list of prohibited substances, it cannot be discounted that athletes might avoid caffeine because of concerns about being perceived as engaging in doping. Perhaps these messages about caffeine supplementation explain the discrepancy between the perceptions of caffeine as a performance enhancer (57%) and the incidence of its use (13%) among team-sport players (Alaranta et al., 2006).

Therefore, the purpose of the study was twofold: first was to examine the effects of caffeine on performance of a succession of open skills specific to the demands of skillful soccer performance, and second was to further examine the effects of caffeine on physical (sprinting and jumping performance), physiological, and perceptual measures during a simulated team sport.

**Methods**

**Participants**

Twelve male soccer players (age 23.8 ± 4.5 years, BM 71.4 ± 7.4 kg, VO$_{2\text{max}}$ 56 ± 4 ml · kg$^{-1}$ · min$^{-1}$) volunteered, with informed written consent, to participate in this study approved by the Massey University Ethics Committee. Participants were required to be 18–35 years of age and playing in the regional premier division during the season of the trials. They varied in level of daily caffeine consumption (estimated range 0–350 mg/day based on self-reported daily consumption of common caffeine sources). Potential participants reporting any adverse reactions to caffeine were excluded.

**Preliminary Measurements**

Participants reported to the laboratory for two familiarization trials. At the first of these they performed a multistage fitness test (Ramsbottom, Brewer, & Williams, 1988) to estimate their maximal oxygen consumption (VO$_{2\text{max}}$) and to establish the running speeds for the main trials. They also performed a minimum of five attempts of the Loughborough Soccer Passing Test (LSPT). In the second familiarization trial participants performed the intermittent shuttle-running protocol (LIST) for 45 min to familiarize themselves with the running patterns and experimental procedures. They also had the opportunity to perform as many attempts of the LSPT as needed until they were comfortable with the test procedures and their scores indicated that the learning component of typical variation had diminished.
(i.e., a plateau in score). Participants were grouped for the main trials by first being matched for VO$_{2\text{max}}$ values and then, when possible, sprint performance. This was so that the competition between the participants would increase motivation throughout the experimental protocol.

**Experimental Design**

Participants performed two experimental trials separated by 7 days. Repeat trials were performed on the same day of the week and at the same time to minimize any diurnal variations among measures. To eliminate any trial-order effect, treatments were assigned randomly with a crossover design. On each occasion, participants ingested a gelatin capsule containing 6 mg/kg BM of either anhydrous caffeine powder (CAF; Reagent Plus, Sigma-Aldrich) or a placebo (PLA) in a double-blind fashion, along with 500 ml of water, 60 min before exercise. The capsules were ingested intact to minimize any organoleptic responses to the treatments. Participants abstained from caffeine, alcohol, and strenuous activity and recorded their dietary intake for 48 hr before the main experimental trials, then replicated their dietary intake before the second main trial. A schematic of the experimental design is displayed in Figure 1.

Participants reported to the laboratory for the experimental trial and voided before the measurement of near-nude (underwear) BM. Ten minutes before commencing the main trials, they completed a 10-min soccer-specific standardized warm-up and stretching protocol.

On completion of the 90 min of intermittent running participants voided, with a sample collected for later analysis of urine specific gravity by a handheld refractometer (Sur-Ne, Atago Co. Ltd., Japan), vapor-pressure osmometry (Wescor 5500 vapor-pressure osmometer), and urine caffeine concentration (via HPLC method) before measurement of near-nude BM.

The exercise protocol used in the main experimental trials was the LIST. The LIST is a free-running exercise protocol of variable intensity that has been validated as a reliable simulation of the activity patterns of a soccer game. Participants ran the LIST for 90 min in six blocks of 15 min separated by 4-min rest periods. Each 15-min LIST block consists of approximately 11 cycles of activity, each cycle involving $3 \times 20$-m walk at 1.54 m/s, $1 \times 15$-m maximal sprint, $1 \times 4$-s standing rest, $3 \times 20$-m jog at 55% VO$_{2\text{max}}$ pace, and $3 \times 20$-m run at 95% VO$_{2\text{max}}$ pace (see Nicholas, Nuttal, & Williams, 2000, for a detailed methodology).

Before beginning the LIST, and during the rest periods, participants performed one attempt of the LSPT after a countermovement jump (CMJ) on a jump mat (Just Jump System 7610, Perform Better, USA). Throughout the CMJ the participants’ hands remained firmly on their hips.

The LSPT has been shown to be a valid and reliable indicator of soccer skill performance, especially in players of high ability. It requires the participant to complete a circuit of 16 passes against colored targets placed on rebound boards surrounding the playing area. A passing zone and a receiving zone are indicated within the playing area by marker lines and cones. The next desired target is denoted by an audible signal immediately after each pass. The participant must complete the passes as quickly as possible while minimizing errors. Penalty time
Figure 1 — A schematic of the experimental design. LIST = intermittent shuttle-running protocol; LSPT = Loughborough Soccer Passing Test; CMJ = countermovement jump; RPE = rating of perceived exertion.
is added for errors (passing inaccuracy, playing from an incorrect zone, poor ball control, etc.), penalty time is deducted for a perfect pass, and movement time is the time to complete the test. Total time is the sum of movement time and penalty time (see Ali et al., 2007, for a detailed methodology).

The order in which the paired participants completed the CMJ and LSPT was maintained during each rest period and across both trials. Water (3 ml/kg BM) was ingested during the rest phases of the protocol.

Heart rate was monitored every 15 s during exercise using short-range telemetry (Polar Model 610, Kempele, Finland), and the mean was recorded for each 15-min exercise period. Subjective ratings of perceived exertion were recorded using the Borg scale (Borg, 1973) during the walk phase of the eighth cycle of each block.

On completion of the second main trial, participants were asked to indicate whether they could identify which treatment (caffeine or placebo) they had been given in which trial.

**Statistical Analyses**

Statistical comparisons were analyzed using a two-way (Treatment × Time) analysis of variance (ANOVA) for repeated measures (SPSS 15). Mauchly’s test for sphericity was used; when sphericity was assumed the Greenhouse–Geisser correction was used for epsilon < .75; if not, the Huyn–Feldt correction was used. When significant $F$ values were found a Holm–Bonferroni stepwise method was used to determine the source of the variance (Atkinson, 2002). When there were only single comparisons a Student’s $t$ test for correlated data was used to determine whether there were any differences between treatments. Pearson product-moment correlations were calculated to identify the strength of linear dependence between habitual caffeine consumption and performance measures. Null hypotheses were rejected at an alpha level of $p < .05$. All data are reported as $M ± SD$.

**Results**

**Skill Performance**

Performance of the LSPT was enhanced by caffeine ingestion (Table 1). Participants’ total time during the LSPT was significantly faster (4.3%) in CAF than in PLA (CAF 51.6 ± 7.7 s vs. PLA 53.9 ± 8.5 s; $p = .02$). There were no differences between trials in movement time during the LSPT, so the enhanced performance was attributable to a significant decrease (20%) in penalty time during the CAF trial (9.7 ± 6.6 s vs. PLA 11.6 ± 7.4 s; $p = .02$; Figure 2). This decrease in penalty time was probably attributable to increased passing accuracy (perfect passes) in the CAF trial ($p = .06$) because there were no statistical differences between trials for any of the other factors contributing to penalty time.

**Exercise Performance**

Caffeine had no effect on sprint performance, with similar 15-m sprint times between trials (CAF 2.42 ± 0.13 s vs. PLA 2.44 ± 0.13 s), although there was a
Table 1  Performance on the Separate Components of the Loughborough Soccer Passing Test in the Caffeine and Placebo Trials, $M \pm SD$, $n = 12$

<table>
<thead>
<tr>
<th></th>
<th>Pre-LIST</th>
<th>Post Block 1</th>
<th>Post Block 2</th>
<th>Post Block 3</th>
<th>Post Block 4</th>
<th>Post Block 5</th>
<th>Post Block 6</th>
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<tr>
<td><strong>Caffeine</strong></td>
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<tr>
<td>perfect pass ($n$)†</td>
<td>6.8 (1.5)</td>
<td>7.1 (1.6)</td>
<td>6.1 (1.6)</td>
<td>6.5 (1.5)</td>
<td>6.4 (1.6)</td>
<td>5.9 (1.2)</td>
<td>6.1 (1.2)</td>
</tr>
<tr>
<td>movement time (s)</td>
<td>42.4 (3.7)</td>
<td>41.5 (5.1)</td>
<td>41.7 (2.6)</td>
<td>42.7 (3.2)</td>
<td>42.2 (3.5)</td>
<td>41.9 (2.7)</td>
<td>41.5 (3.4)</td>
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<tr>
<td>penalty time (s)*</td>
<td>9.2 (4.2)</td>
<td>7.8 (5.6)</td>
<td>9.9 (6.9)</td>
<td>10.3 (8.6)</td>
<td>11.8 (8.1)</td>
<td>9.0 (5.4)</td>
<td>9.5 (7.7)</td>
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<tr>
<td>total time (s)*</td>
<td>51.6 (6.6)</td>
<td>49.3 (6.2)</td>
<td>51.6 (9.1)</td>
<td>53.0 (10.7)</td>
<td>54.1 (7.9)</td>
<td>51.0 (6.4)</td>
<td>51.0 (7.4)</td>
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<td><strong>Placebo</strong></td>
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<tr>
<td>perfect pass ($n$)</td>
<td>5.2 (1.2)</td>
<td>4.9 (1.8)</td>
<td>6.0 (2.2)</td>
<td>6.6 (1.5)</td>
<td>5.9 (2.3)</td>
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<td>total time (s)</td>
<td>56.1 (7.1)</td>
<td>57.4 (9.3)</td>
<td>53.3 (14.6)</td>
<td>49.3 (5.3)</td>
<td>51.0 (7.3)</td>
<td>55.3 (8.7)</td>
<td>54.8 (6.9)</td>
</tr>
</tbody>
</table>

*Note. LIST = intermittent shuttle-running protocol.
†Main effect between trials ($p = .06$). *Significant main effect between trials ($p < .05$).
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significant effect of time, with sprint performance decreasing with exercise duration in both trials ($p < .001$).

Functional leg power, as measured indirectly by the CMJ, was significantly higher in the CAF trial (57.1 ± 5.1 cm vs. PLA 55.6 ± 5.1 cm; $p = .01$). Participants jumped 2.7% ± 1.1% (range 1.4–4.7%) higher in the CAF trial than in the PLA trial (Figure 3).

There were no apparent relationships between habitual caffeine consumption and outcome in any of the performance measures.

**Physiological Responses**

There were no differences between trials for heart rate. The average heart rate was 164.2 ± 10.5 beats/min throughout the CAF trial and 166.3 ± 10.6 beats/min during the PLA trial.

There was no evidence that caffeine increased urine output, with similar body-mass losses (CAF 1.1 ± 0.5 kg vs. PLA 1.0 ± 0.4 kg), postexercise urine specific gravity (CAF 1.021 ± 0.007 vs. PLA 1.020 ± 0.008), and osmolality (CAF 742.9 ± 315.8 mOsm/kg vs. PLA 601.6 ± 271.4 mOsm/kg) between trials.

There was a difference in postexercise urinary caffeine concentrations between trials, with significantly higher values reported in the CAF trial (5.0 ± 2.3 µg/ml vs. PLA 0.3 ± 0.3 µg/ml; $p < .001$).

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**Figure 2** — Total time (movement time ± penalty time; s) to complete the Loughborough Soccer Passing Test (LSPT) in the caffeine (CAF) and placebo (PLA) trials after each 15-min block of the intermittent shuttle-running protocol, $M \pm SD$, $n = 12$. *Main treatment effect, with total time significantly faster in the CAF trial ($p = .02$).
Subjective Responses

There were no differences between trials for participants’ ratings of perceived exertion, although there was a significant effect of time, with perceptions of effort increasing with exercise duration in both trials ($p < .001$).

Four participants correctly identified the caffeine and placebo trials, 3 incorrectly identified the trials, and 5 declined to commit to an answer because they were unsure of the order. Of these, 3 felt that they had been on caffeine for both trials. Although because of sample size it is not possible to perform statistical tests, there is no evidence that the perception of treatment order affected the performance outcomes. Some participants performed better on some measures on the trial they perceived to be CAF, whereas others performed worse and some had similar performances regardless. Similarly, habitual caffeine consumption had no apparent link to the ability to identify the CAF trial.

Environmental Data

The average environmental conditions for all experimental trials were $19.3 \pm 2.7 \degree C$, $61.3\% \pm 8.8\%$, and $757.9 \pm 10.9$ mm Hg for temperature, relative humidity, and barometric pressure, respectively. There were no trial-order or experimental differences in any of these measures.
Discussion

The main finding from the current study is that caffeine ingestion before a simulation of key components of soccer match play improved players’ passing accuracy and skilled performance. Furthermore, it increased functional leg power, as measured by jump height, although it had no effect on 15-m sprint performance.

Skill is paramount for success in soccer. The LSPT includes measures of passing accuracy, dribbling ability, recognition and response to visual and audible stimuli, and the player’s ability to receive the football under control. In the current study caffeine improved the skill performance of the participants as evidenced by a 20% reduction in penalty time during that trial. This reduction in errors is probably a result of increased accuracy while passing to the desired target (i.e., more perfect passes). This finding concurs with those of Stuart et al. (2005), who reported that their rugby players were 10% more accurate in passing from the floor at a static target marked on a target wall after caffeine ingestion. Moreover, a study by McLellan, Kamimori, Bell, et al. (2005) indicated improved rifle marksmanship after caffeine ingestion in military personnel during simulated warfare.

In the current study, during each attempt of the LSPT, the participants performed a series of consecutive passes at different targets using the same football. Other than the first pass, the following 15 passes were initiated from a dynamic starting position depending on the previous pass. This necessitated good control of the ball and an appropriate receiving position as the ball rebounded from the target board. An enhanced proprioceptive response after caffeine ingestion would have contributed to the improvements to passing accuracy; however, there were no statistical differences in the other aspects contributing to penalty time, such as passing from an incorrect zone or making contact with marker cones.

Furthermore, each consecutive target was only identified to the participant as he was receiving the rebounded ball, thus requiring him to adjust his positioning and actions in response to these stimuli. This required cognitive functioning at a more complex level than merely hitting a target and is more reflective of the open skills evidenced in soccer match play. In a study on simulated urban warfare, Gillingham et al. (2004) reported improved marksmanship after caffeine ingestion but no difference in the complex cognitive-processing task of friend–foe discrimination. In the current study this may have been displayed as accurate passing but at an incorrect target—or, more practically in soccer match play, passing accurately but to the wrong player. In the current study it appears that caffeine improved the more complex cognitive-processing task of interpreting and responding to audible and visual stimuli.

The increased performance in the LSPT suggests that an oral dose of caffeine equivalent to 6 mg/kg BM does not lead to overarousal and decreased soccer performance as purported by Hespel et al. (2006). The improvements in the LSPT were attributable to a decreased error rate rather than participants’ actual movement time, which suggests that the mechanism of effect is an enhancement of fine motor skills such as ball control and accuracy rather than the gross motor skill of faster body movement. Although extremely fine motor skills have been shown to be negatively affected by caffeine-associated tremor (Urso-Baiarda et al., 2007),
this is not apparent in the type of skills required for soccer passing, ball control, and cognitive processing of relevant stimuli.

The evidence that the beneficial effects of caffeine in the current study were not necessarily related to changes in gross muscle activity is supported by the lack of any differences between trials for 15-m sprint performance. Similar data have been reported by Paton et al. (2001), who observed no effects of caffeine on repeated 20-m sprint performance, although they did highlight some potential methodological weaknesses in this aspect of their study. The current study, however, addressed these limitations and still supports the assertion that caffeine ingestion does not improve sprint performance. This is in accordance with data from Lorino, Lloyd, Crixell, and Walker (2006), who reported no beneficial effect of a similar dose of caffeine on an agility running task.

Despite no observable differences in gross muscle activity during the functional movement patterns in the LSPT and the 15-m sprint, caffeine did have a positive effect on jump height, a measure of functional leg power. The elevated CMJ performance in the CAF trial (2.7% ± 1.1%) throughout the duration of the experimental protocol concurs with the data of Kalmar and Cafarelli (1999), who reported an increased maximal voluntary contraction of the vastus lateralis muscle after ingestion of the same quantity of caffeine as in the current study. They attributed this to increased activation at a supraspinal level through the action of caffeine as an adenosine antagonist and the concomitant release of inhibition in the motor cortex. A further mechanism of action could be a more favorable intracellular ionic environment in the active muscle after caffeine ingestion, thus facilitating increased force production by the motor units (Graham, 2001).

It is difficult to compare the increased CMJ height reported in this study with performance measures in many other caffeine-intervention studies on short-duration exercise because the nature of the CMJ is extremely explosive and the action and duration are dissimilar to sprint running, cycling, and even maximal voluntary contractions, which are the normal modalities in such studies (Bell et al., 2001; Collomp et al., 1992; Schneiker, Bishop, Dawson, & Hackett, 2006). The duration of action and the simplicity of the technique could further serve to explain why differences were noted in CMJ but not in 15-m sprint performance or movement time during the LSPT in the current study. Although the elevated leg power did not translate into increased sprint performance in the current study, the ability to generate greater muscle power after caffeine ingestion may have considerable practical relevance to soccer players with regard to functional explosive activities (e.g., jumping and tackling).

In addition to sprint performance being similar between trials, there were no differences in participants’ heart rates during the LIST. Although elevated heart rate is a commonly reported finding in caffeine-intervention studies, this was not observed in the current study. The nature of the LIST is such that all movement intensities (except for the sprint) are standardized by audible signals, so it is not possible for a participant to self-pace at any stage of the 90 min. Because there were no differences in sprint performance between trials, we can determine that participants were performing the same physiological workload in both trials, thus explaining the similarities in heart rate. Decreased perception of effort during both endurance and high-intensity exercise is another commonly reported finding
after caffeine ingestion (see Doherty & Smith, 2004 for a meta-analysis); however, this again was not apparent in the current study.

We asked participants to abstain from caffeine-containing food sources for 48 hr before main trials, and, although this was not directly measured, their pretrial dietary records indicate that they complied with our recommendations. The negligible urine caffeine concentrations (0.3 ± 0.3 µg/ml) for the PLA trial further confirm that abstinence was maintained. The ergogenic effects of caffeine on skill and CMJ performance were evident regardless of the extent of participants’ habitual caffeine consumption. Haskell et al. (2005) found improvements in cognitive function in both habitual and nonhabitual caffeine users, although their habitual-user group did report improved mood changes after ingestion. It is therefore likely that the effects of caffeine in the current study are not mediated through a withdrawal-alleviation model in the habitual consumers and are more likely a caffeine-mediated effect, probably through caffeine’s role as an adenosine antagonist. This is somewhat supported by the participants’ apparent inability to determine which treatment was used in which trial. This maintenance of the blinding of participants to treatment is important in relation to observations from Fillmore and Vogel-Sprott (1992), who reported a placebo response in motor-skill performance in participants who believed they were receiving caffeine.

The provision of 6 mg/kg BM of caffeine 60 min before exercise did elevate urine caffeine concentrations, but none of the participants displayed postexercise concentrations in excess of the 12-µg/ml upper limit that the International Olympic Committee and the World Anti-Doping Agency previously used to determine doping infringements. Caffeine is often purported to have a diuretic effect, but the fluid-balance variables measured indicate that this was not evident during the current study. The mean caffeine ingestion in the current study was 432.9 ± 43.7 mg, and numerous studies have failed to report any elevated diuresis after moderate (<456 mg) caffeine ingestion (see Armstrong, Casa, Maresh, & Ganio, 2007, for a review).

In conclusion, the main finding from the current study is that caffeine ingestion before simulated soccer activity improved the passing accuracy and ball control of players. Furthermore, it increased functional leg power without any detrimental effects on other physiological or performance parameters. Therefore, supplementation with caffeine before match play may be beneficial for the skilled performance of soccer players.

References


