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Effect of caffeine ingestion on blood lactate and FFA in young taekwondo players after interval exercise

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Abstract

The purpose of this research was to study the effect of caffeine supplement ingestion on Free Fatty Acid (FFA) and lactate (LA) in young taekwondo players after specific interval exercise. 18 young taekwondo players were selected with the averages of age 18.33± 1.3 yrs, weight 65.50±4.75 kg and then divided in 3 groups (6 persons per group), randomly. Subjects participated in two -phase specific interval activity protocol (before and after caffeine ingestion) with 48 hours rest in between. First group, performed specific interval activity in 6 minute, but second group, performed two-phase of specific interval activity in 6 minute with an hour active recovery between them. The third group performed same activity in three phases. Blood samples were taken in two phases (before and after caffeine ingestion), each phase in three steps (immediately after three phases of test). Data were analyzed by one way ANOVA and LSD in significant level P≤0.05. Results showed non-significant increase in FFA and blood lactate, except lactate changes in first group. Based on our findings it seems that caffeine supplement did not show any significant effect on FFA, lactate or metabolisms in young taekwondo players. As such caffeine ingestion did not demonstrate any increased fat lipolysis or any effect on lactate accumulation in taekwondo players.

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Introduction

Increasing development of new research findings in the field of exercise science and sports has made astounding leaps (Jeukendrup *et al*., 2009). To excel in international competitions, athletes and coaches utilize various facilities and tools. In this regard, a key element of improving athletic performance, along with techniques, tactics and physical fitness, is proper nutrition and supplements. The caffeine supplements, having shown to have a positive effect on activity of athletes, seem to be the perfect complement to improve the Taekwondo player's performance (Bell *et al*., 2000; Bell *et al*., 2002; Davis *et al*., 2003; Doherty *et al*., 2005; Greer, 2000; *Hadjicharalambous et al*., 2006).

The effect of caffeine on free fatty acids (FFA) and blood lactate response has been contradictory (Leandro *et al*., 2006). In their review of literature found conflicting results with regards to effects of caffeine on maximal and sub-maximal short-term exercise (Leandro *et al*., 2006). Although it appears that caffeine improves the short-term (less than 5 minutes) maximal exercise performance significantly, it has no influence on sub-maximal exercise (Leandro *et al*., 2006). In the study the effects of caffeine on repeated high-intensity exercise (Wingate test) and concluded that caffeine had no significant effect on the levels of blood lactate, the concentration of catecholamines, and aerobic contribution at each stage of the training. They reported caffeine consumption could not cause an increase in power output during repeated high-intensity exercise (Graham *et al*., 2002). In weight class sports such as taekwondo, athletes are usually engaged in short intervals of high intensity exercise as they progress to final stages on competition day. As such to optimize performance, it is important to recover the lost ATP-PCr reserves, to dispose extra lactic acid and plasma FFA produced during the match. If caffeine supplementation can increase time to exhaustion by increasing the ATP-PC system capacity, and delay the onset of anaerobic glycolysis and lactic acid accumulation and release of blood FFA, Taekwondo players can be expected to have enhanced performance especially in the final rounds of competition. Some studies indicated improved runtime aerobic activities after caffeine supplementation (Bell *et al*., 2000; Doherty *et al*., 2005; Norager *et al*., 2006). In contrast, some studies have not confirmed performance enhancement (Leandro *et al*., 2006; Graham *et al*., 2002). In addition, some authors have shown significant effect on plasma lactate after caffeine consumption (Norager *et al*., 2006; Conway *et al*., 2003), whereas others failed to do so (Doherty *et al*., 2005; Knut *et al*., 2006). The effects of caffeine on FFA are contradictory. Some studies showed an increasing of FFA after consumption of caffeine (Bell *et al*., 2000; Cox *et al*., 2002), but reported no change in FFA after taking this supplement (Bruce *et al*., 2000). Despite the inconsistencies mentioned above athletes tend to continue to consume caffeine in hope of improving their performance (Leandro *et al*., 2006). Furthermore there are only a few studies that had examined the effects of caffeine on Taekwondo player's performance. As such we conducted this study to investigate effects of caffeine on blood lactate and blood FFA concentration in Taekwondo players after interval exercise.

Methods and materials

This study is semi experimental research. Eighty five male Taekwondo athletes filled up a questionnaire and were interviewed. Eighteen male Taekwondo players (mean age, 18.33 ± 1.3 years and weighing 65.50 ± 4.75 kg, with a history of practice 6.1 ± 1.05 years) that have never taken tany supplements were selected. Each athlete had approximately 6 years of experience in Taekwondo. All subjects had 3 taekwondo practice sessions per week. The subjects were divided into three equal groups based on body weight and maximal oxygen consumption (each group n=6) with no significant mean difference among groups. Table 1 shows the characteristics of the three groups of subjects.

Subjects participated in pre-test and post-test. In the

pre-test, subjects in the first group performed taekwondo specific interval activity for 6 minutes (Table 2). Subjects kicked with foot to the Mitt, 6 bouts for 30 seconds without interruption, followed by 30 seconds of active rest between each bout. Blood sampling for FFA and plasma lactate was performed immediately after activity and were transferred to the laboratory.. The blood samples were taken two and three times for second and third group respectively with an hour interval between each activity. Post-test was performed 48 hours after pre-test to avoid fatigue and negative effects of pre-test. In post-test day, subjects were given caffeine capsules (containing 6 milligrams of caffeine per kilogram of body weight, packaged and distributed by the German company, Merck) to take with 250 cc of warm water, an hour before the specific activity. The pre-test training program was repeated in all three groups to evaluate the effect of this supplementation on plasma lactate and FFA. Statistical analyses were performed using SPSS computer programs. Kolmogorov-Smirnov and Levine's test for homogeneity of variance was used to evaluate the normality of the distribution of the test. T-test and one-way ANOVA tests were used for data analysis. Significance level for hypothesis testing was set as $P \leq 0.05$.

Results

Table 3 shows the results of this study. The FFA concentration decreased in first group after caffeine supplement ingestion but this reduction was insignificant statistically (P=0.933). Also, the blood lactate concentration increased significantly after caffeine supplementation (P=0.04). The FFA concentration in second group increased insignificantly after caffeine supplementation (P=0.342). Also, the blood lactate concentration increased but this increase was insignificant statistically (P=0.589). In third group, the FFA concentration decreased insignificantly after caffeine supplementation (P=0.084). The blood lactate concentration increased after caffeine supplementation that this was insignificant (P=0.252).

Table 1. Subject characteristics.

Variable	First group	Second group	Third group
Age (y)	19.12 ± 0.82	17.75 ± 1.82	18.12 ± 1.24
Weight (kg)	64.33 ± 4.49	65.08 ± 5.73	67.10 ± 4.03
Height (cm)	175.50 ± 5.04	173.93 ± 3.63	175.06 ± 4.84
Vo_2 max (ml/kg/min)	48.97 ± 2.23	49.36 ± 1.80	48.96 ± 2.05
Training experience (y)	6.75 ± 1.66	5.93 ± 1.08	6.00 ± 1.38

Values are mean ± SD.

Table 2. Special interval exercise.

Bout	Activity	Activity time (s)	Activity rest time (s)
1	kick with foot to the Mitt	30	30
2	kick with foot to the Mitt	30	30
3	kick with foot to the Mitt	30	30
4	kick with foot to the Mitt	30	30
5	kick with foot to the Mitt	30	30
6	kick with foot to the Mitt	30	30

Discussion

The results of this study showed that the FFA levels decreased in the first and third group after caffeine ingestion but this factor increased in second group. These changes were not statistically significant. The blood lactate levels increased in three groups but this increase was only significant in first group (P=0.04). These results are consistent with the findings of some

studies (Conway *et al*., 2003; Knut *et al*., 2006; Cox *et al*., 2002; Bruce *et al*., 2000) and contrary to others (Bell *et al*., 2000; Davis *et al*., 2003; Doherty *et al*., 2005; Greer, 2000; Okudan *et al*., 2005). This may be due to various confounders such as the sample size, supplementation amount, the type of test and duration of the tests used. According to the research results, it can be inferred that caffeine can affect on the levels of plasma FFA (Cox *et al*., 2002; Bruce *et al*., 2000). Long-term aerobic exercise is often reliant on energy from fat lipolysis. On the other hand, long activities stimulate the secretion of catecholamines and subsequently lead to an increase in lipolysis. In this process, triglycerides are broken down into FFA and glycerol. FFA enters the beta-oxidation cycle and after the formation of acetyl coenzyme A enters the Krebs cycle and contributes to the process of energy production. Thus, the secretion of hormones such as cortisol, epinephrine, and growth hormone induced by exercise and physical activity are an important factor in increasing fat lipolysis (Norager *et al*., 2006). In the present study we did not measure levels of epinephrine, norepinephrine and cortisol after caffeine ingestion. However, we found caffeine increased plasma FFA levels in post-test, but this increase was not statistically significant. However, non-significant increase in plasma FFA levels in subjects may be due to the direct effect of caffeine. The lack of significant effect of caffeine on plasma FFA levels can be due to the intensity, duration and type of exercise, and the amount of caffeine intake. Taekwondo players had a short term and interval training, which are anaerobic lactic in nature. Hence, it is likely that no significant increase in FFA after caffeine ingestion is related to the type of training given to athletes. Contrary to other studies (Norager *et al*., 2006; Dishman *et al*., 2003), we did not find any significant increase in plasma lactate levels (Except for the first group) with ingestion of caffeine in Taekwondo athletes. Taekwondo is an anaerobic activity (Bell *et al*., 2002), as such it is likely that the high lactate threshold of Taekwondo players has been a major factor in the lack of significant increase of plasma lactate after specific interval activity. The limitations of our study are low sample size per group and male only subjects. It would also be beneficial to measure levels of epinephrine, norepinephrine and cortisol after caffeine ingestion. Therefore, we can conclude that caffeine ingestion and high lactate threshold of Taekwondo players can be a major factor in the lack of significant increase in plasma lactate after specific interval activity. Based on our findings, caffeine supplementation may not have a significant effect on lactate levels and plasma FFA of Taekwondo players. To clarify the actual effects of this supplement, we suggest reproducing this study in other anaerobic lactic system sports.

Table 3. FFA and lactate (LA) concentrations in three groups.

Factor	Group	Pre-test	Post-test	p
FFA (mmol/L)	First	0.82 ± 0.28	0.80 ± 0.29	0.933
	Second	0.70 ± 0.21	1.07 ± 0.83	0.342
	Third	1.05 ± 0.51	0.97 ± 0.15	0.084
LA (mg/dl)	First	88.75 ± 21.28	129.25 ± 26.98	0.04
	Second	127.50 ± 20.12	140.00 ± 11.22	0.589
	Third	92.75 ± 24.00	109.50 ± 24.00	0.252

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