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ORIGINAL ARTICLE

Investigating the Effect of Caffeine on Metabolic and Cardiovascular Responses to Submaximal Activities in Men Athlete Performing Aerobic

Mohammad Khazaei[1] , Naser Behpour[1] , Ahmad Hematfar[1]
[1] Department of ,Physical Education and Sports Science, Islamic Azad University, Boroojerd Branch, Boroojerd, Iran

ABSTRACT
The purpose of the present study was to investigate the effect of caffeine on metabolic and cardiovascular responses during submaximal activities in men athlete performing aerobic. The statistical population included 20 men athletes performing aerobic divided into two 10-people groups. Both groups were evaluated in the first session and their height, weight, fat percentage, BMI, and oxygen consumed during the practices were measured with 75% of their maximal. Then, after passing a night before the treatment in fasting status for 10 hours, in the first group, caffeine capsule (5 mg for 1 kg of body weight) and in the second group, a placebo was used with 200 ml water. They passed one hour in sitting position and until reaching to the heart rate of 75% of the maximal, they ran on the treadmill based oncontinuous incremental protocol. They continued to this trend for 15 minutes and finally, the mount oxygen consumed during the activity, heart rate,systolic and diastolic blood pressure, and blood lactate level after the activity in the two stages (the stage with placebo and the stage without placebo) were measured and recorded. As the findings revealed, in the group consumed caffeine, heart rate ($P < 0.001$) and consumed oxygen ($P < 0.001$) were significantly increased while no significant difference was observed in other measured parameters. Notably, no significant difference was found in the studied parameters in the group consumed placebo.
Keywords: *Caffeine, Submaximal Activity, Athlete*

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INTRODUCTION

Caffeine or three methylxanthines [1-3] is a substance found in foods especially tea, coffee, cocoa, various chocolates, and some drinks. According to previously reported studies, during aerobic practices, caffeine causes the increase of reliance on fat in energy catabolism [4]. There are some evidences indicating that the metabolic effects of caffeine lead to the temporary increase of calorie consumption level in the resting state [5, 6]. Many researchers have studied the effect of caffeine on the performance of athletes from different aspects and reported different results. For example, regarding metabolic responses, some researchers showed that caffeine significantly increases fat oxidation and energy consumed during long term activities with low and average intensity [7, 8], while other researchers have not confirmed such findings [9-11]. Additionally, regarding cardiovascular disease, Ebrahimi et al. [10] reported that caffeine leads to the increase of systolic and diastolic blood pressure in the resting state but hear rate is not influenced; while. Herman [12] and Jason [13] believed that there are various studies indicating that caffeine has various and sometimes contrast cardiovascular effects. The above mentioned results, on the one hand, and lack of any study on submaximal activity aspect on subjects, on the other hand caused to conducted the present project. The purpose of the study is to examine the effect of caffeine on metabolic and cardiovascular responses to submaximal activity in men athlete performing aerobic practices.

Caffeine, naturally, is obtained from alkali plants [14] and belongs to methylxanthines class. Methylxanthines include theophylline and theobromine. More than 60 various plant species found that contain caffeine [15]. Caffeine is considered as a stimulant and drug since it has no food vale [16].

In liver, caffeine is metabolized through cytochrome enzyme system of p430. Caffeine is rapidly absorbed from the digestion path and within 20 minutes, about 90% of caffeine is absorbed through stomach.

About 40 to 60 minutes later, the climax of caffeine's plasma concentration is obtained and its half-life is about 3 to 5 hours. Caffeine passes through blood-brain barrier (BBB) as well as placenta.
Antagonism of adenosine receptors, preventing the activity of phosphodiesterase (the enzyme building annular AMP), increasing calcium and antagonism of benzodiazepines receptors are considered as the proposed mechanism of these effects.
Often, useful effects of caffeine are related to the increase of consciousness level and the improvement of mental performance, especially in sleep shortage [20]. In sleep tests, the time of going to sleep was increased after consuming caffeine. Additionally, a study on ship's captains revealed that during 24-hour periods of wakefulness, consuming caffeine causes to maintain performance and decrease of pressure perception level .Most of studies conducted on the effect of caffeine on the performance of athletes have focused on resistive and submaximal activities such as running and biking. In these situations, caffeine, generally, causes the improvement of maintain sport performance and the increase of activity duration or the decrease of pressure perception. Other advantages of caffeine in sport is the improvement of playing tennis and the decrease of 1500 m swimming time [10].as it has been reported, ergogenic effects of caffeine can be observed regardless of its consumption time (whether before or during the activity) [21].
However, caffeine can be harmful. For example, it can lead to motor disorder, heart rate increase, diuresis, insomnia, irritability, and high anxiety [22].
Some studies showed that caffeine cannot create any change in RER. However, some studies reported that caffeine causes the decrease of RER. Additionally, there is no research indicating that caffeine causes the increase of RER. There are also studies indicating that caffeine causes the increase of consumed energy while some others have not been able to confirm such a finding [23].
Macklaren et al., [25] investigated the effect of two low dosage of caffeine on heart rate and blood pressure in various intensities if activities. 6 male tests randomly received placebo, 1.5 mg/kg and 3 mg/kg caffeine in different days. 30 minutes after consumption, heart rate, blood pressure, consumed oxygen, respirator exchange ratio, and perceived stress in resting status and rodding on the bicycle ergometer status during 5-minute stable status were measured using output power of 60w, 120w and 180w in anexhaustive incremental test.
Consuming 3 mg/kg caffeine in resting status, 60 w and 120 w statuses caused the decrease of heart rate while it was not so in 180 w. Consuming 1.5 mg/kg caffeine also caused the decrease of heart rate in submaximal work pressure but it was not significant. Additionally, consuming 3 mg/kg caffeine, RER was lower in resting status and activity status. Blood pressure, consumed oxygen and perceived stress were not change by consuming caffeine. The maximum output power and exhaustion reaching time in incremental test was not different in various statuses. They asserted that it was the first research indicated that consuming average caffeine can significantly decrease heart rate in the activity of riding ergometer bicycle lack of change in heart rate in the activity with higher intensity and lack of consumed oxygen suggested that stroke volume, probably, is increased in low intensities by consuming caffeine. This study also revealed that consuming one or two cup of coffee may influence heart rate in the stress of individuals' selective work (Macklaren et al., 2003).
O'caner et al., [24] investigated the effect of two dosage of caffeine on fatigue feeling in foot muscle and blood pressure during biking with average intensity. 12 male students consumed caffeine below one of the two dosages (5 mg/kg or 10 mg/kg) or placebo one hour before 30-minute biking activity with average intensity (VO_2max%60). In resting status, blood pressure and heart rate were measured and recorded before and one hour after consuming drug. Fatigue feeling in foot muscle and the activity intensity, heart rate and consumed oxygen were recorded during the activity. Caffeine caused to the increase of systolic blood pressure during the resting status but blood pressure was not maintained during the activity. Caffeine effect on the fatigue of foot muscle during the activity depends on the dosage of caffeine consumed and this effect does not depend on the increase of blood pressure due to caffeine during the activity [24].
As observed, regarding the effect of caffeine on heart rate and systolic and diastolic blood pressures, there were also many differences between the results reported by performed studies. In addition to the differences existing in the above mentioned researches, it can be referred to the dosage of caffeine which can be considered as an important factor in creating such responses.

METHODOLOGY

The present work was a quasi-experimental double-blind study. The statistical population included men students of Karaj Azad University performing aerobic exercises. The statistical sample involved 20 people who were divided into an experimental group (10 people) and a control group (10 people). The experimental group received caffeine and the control group received placebo. Considering the fact that the study was double-blind, none of the tests (experimental and control) as well as the researcher were

not aware of the details of consuming two kinds of capsule (which capsule contained caffeine and which one was placebo). Among men aerobic athletes with BMI mean of 24, some were selected through random purposeful method. After completing questionnaire (health questionnaire, caffeine consumption questionnaire), those students who was volunteer to participant in the study, whose daily caffeine consumption was less than 300 mg/kg and were health (non-smoking) were selected.

RESULTS AND DISCUSSION

The Main Research Hypothesis:

Consuming caffeine influences metabolic and cardiovascular responses to submaximal activity of male aerobic athletes.

The Secondary Research Hypotheses:

- Consuming caffeine influences heart rate in submaximal activity of male aerobic athletes.
- Consuming caffeine influences blood pressure in submaximal activity of male aerobic athletes.
- Consuming caffeine influences calorie level consumption in submaximal activity of male aerobic athletes.
- Consuming caffeine influences blood lactate level in submaximal activity of male aerobic athletes.

The Research Hypotheses Analysis

Table 1. Correlation of Pretest and Posttest of the Research Variables for the Testees Received Placebo

		Number	Correlation	Sig.
Hypothesis 1	Pretest and posttest heart rate	10	0/995	0/000
Hypothesis 2	Pretest and posttest systolic blood pressure	10	0/997	0/000
Hypothesis 3	Pretest and posttest diastolic blood pressure	10	1/000	0/000
Hypothesis 4	Pretest and posttest consumed oxygen	10	0/714	0/020
Hypothesis 5	Pretest and posttest blood lactate	10	1/000	0/000

According to Table 1, significance level is less than 0.05, indicating a significant positive correlation between the measurements in pretest and posttest, revealing the accuracy of the experiment.

Table 2. T-Test Results for the Tests Received Placebo

		Pairs difference	t	Degree of Freedom	Sig.
		Difference Confidence levels of 95%			
		High level			
Hypothesis 1	Pretest and posttest heart rate	0/273	-1/64	9	0/177
Hypothesis 2	Pretest and posttest systolic blood pressure	0/04957	-1/878	9	0/093
Hypothesis 3	Pretest and posttest diastolic blood pressure	0/00195	-1/769	9	0/111
Hypothesis 4	Pretest and posttest consumed oxygen	0/09161	-1/379	9	0/201
Hypothesis 5	Pretest and posttest blood lactate	0/00617	-1/399	9	0/195

Shown in Table 2, significance level is greater than 0.05; therefore, there is no significant change between the mean of pretest and posttest in all the variables under the condition in which caffeine did not consumed.

Table 3. Correlation of Pretest and Posttest of the Research Variables for the Testees Received Caffeine

		Number	Correlation	Sig.
Hypothesis 1	Pretest and posttest heart rate	10	0/394	0/261
Hypothesis 2	Pretest and posttest systolic blood pressure	10	0/984	0/000
Hypothesis 3	Pretest and posttest diastolic blood pressure	10	0/990	0/000
Hypothesis 4	Pretest and posttest consumed oxygen	10	-/232	0/519
Hypothesis 5	Pretest and posttest blood lactate	10	0/999	0/000

Table 4. T-Test Results for the Tests Received Caffeine

		Pairs difference	t	Degree of Freedom	Sig.
		Difference Confidence levels of 95%			
		High level			
Hypothesis 1	Pretest and posttest heart rate	-45/077	-20/396	9	0/000
Hypothesis 2	Pretest and posttest systolic blood pressure	0/14578	-1/606	9	0/143
Hypothesis 3	Pretest and posttest diastolic blood pressure	0/05360	-2/034	9	0/072
Hypothesis 4	Pretest and posttest consumed oxygen	-/87131	-8/996	9	0/000
Hypothesis 5	Pretest and posttest blood lactate	0/01882	-0/924	9	0/380

Testing the Research Hypotheses

According to Table 4, significance level is less than 0.05 (P = 0.0001 < 0.05); therefore, the test is significant. So, it can be stated that under the experimental conditions, consuming caffeine has increased heart rate. Also, the significance level for systolic blood pressure and diastolic blood pressure is 0.143 and 0.072, respectively. Accordingly, the test is not significant, indicating that consuming caffeine has not influenced blood pressure in submaximal activity of male aerobic athletes. The significance level for consumed oxygen is also less than 0.05 P = 0.0001 < 0.05); therefore, the test is significant, revealing that under the experimental conditions, consuming caffeine has increased consumed oxygen. Finally, the significance level for blood lactate is 0.380; therefore, the test is not significant, indicating that blood lactate is statistically identical in pretest and posttest and their difference has not been significant.

CONCLUSION

According to the research findings, it can be stated that:

- Under the experimental conditions, consuming caffeine has increased heart rate;
- consuming caffeine has not had any effect on systolic and diastolic blood pressure in men aerobic athletes;
- Under the experimental conditions, consuming caffeine has increased consumed oxygen;
- Consuming caffeine has not had any effect on blood lactate in men aerobic athletes.

Moreover, since most of reported results, generally, indicate that consuming caffeine causes the increase of heart rate and blood pressure and it is consistent with the finding reported by the present paper.

Given to the present research findings, consuming caffeine has no significant effect on performing exercises; accordingly, it is not recommended for improving athletes' performance. It is also recommended to those researchers studying cardiovascular changes to control dosage of caffeine consumed by testers. So, it is suggested to measure the effect of caffeine on individuals' physical status under certain conditions. The effect of caffeine on other physical activities such as concentration and memory can also be explored. Investigating the effect of other substance such as food supplements used in exercises on physiological activities is also suggested.

REFERENCES

1. Bell ,D.G.I.Jacobs , and K.elleringion , (2001) l "Effect of caffeine and aphadrine ingestion an anaerobic axercise performance" , Med . Sci. Sports Exerc.33:pp:1399-1403
2. Saremi. A. and Khamse, A. (1991). Obesity, its causes and relation with exercise, Chehr Publication
3. Ahrendt DM, ergorgrnic aids: counseling the athlete, Am Fam physician, 2001, 63:913-922
4. Costill ,D.L;G.P.Dalsky and W.J.Fink (1978) . "Effect of caffeine ingestion on metabolisim and exercise performance " .Med.Sci.SportExerc . 10:155-158
5. Goodpaster BH, Robert R, Wolfe and David E, Kelley, Effect of obesity on substrate utilization during exercise, Obesity research Vol, 2000, 10: 575-584.
6. Poehlmen ,E.T;J.P.Despres ;H.Bessette ;E.Fontaine ;A.Trembly and C.Bouchard (1985)."Influence of caffeine on the resting metabolic rate of exercise – trained and inactive subjects " .Med.Sei .Sports Exere .17;689-694-
7. Chad.K, and B, Quiegley, (1989). The effects of substrate utilization, ,manipulated by caffeine, on post- exercise oxygen consumption in untrained female subjects, Eur, J, Appl, Physiol, 1989, 59: 48-54.
8. Engles, H, J, LC, Wirth and E.M. Haymes, (2002). Metabolic and ventilator effects of caffeine during light intensity exercise in trained and sedentary low habitual caffeine users, in current research in sports sciences, V.A.

9. Rogozkin and R. Maughan (1996). NewYork, Plenum Press, (Eds). pp, 321-332.
10. Ciocca M, Medication and supplement use by athletes, clin sports Med, 2005, 24:719-738.
11. Turley KR, Gerst JW, Effect of caffeine on physiological responses to exercise in young boys and girls, Med, Sci, Sports Exerc, 2006, 38 (3): 520-526.
12. Ebrahimi, M.; Rahmani Nia, F.; Damirchi, A. (2007). The effect of consuming caffeine on metabolic and cardiovascular responses to submaximal activity in fat and thin men. Olympic, no. 44, 17-27
13. Hermann J Engles, et al, (1999). Influence of caffeine on metabolic and cardiovascular functions of during sustained light intensity cycling and at rest, international journal of sport nutrition, 1999, 9(4): 361-370.
14. Jason W, Daniel S, et al, (1998). Effects of caffeine on blood pressure, heart rate, and forearm blood flow during dynamic leg exercise, J Appl Physiol, 85(1): 154-159.
15. Mellion MB, Walsh WM, Madden C, et al (2002). Team physicians Handbook, Ed3, Philadelphia, Lippincott Willams& Wilkins: 186.
16. Rogers Nl, dinges DF, Caffeine: (2005). Implications for alertness in athletes. Clin Sports Med, 24: e1-e13
17. Leski MJ, Terrell TR, (2002). Nutrition and ergogenic and, In textbook of family practice eds 6 edited by rakel RE, Philadelphia: WB Saunders, 856.
18. Davis JM, Zhao, Z, Stock HS, et al, (2003). Central nervous system effects of caffeine and adenosine on fatigue, J Appl Physiol, 284: 399-404.
19. Bell DG, Mclellan TM, (2002). Exercise endurance 1,3, and 6 h after caffeine ingestion in caffeine users and nonusers, J Apple Physiol, 93: 1227-1234
20. Jordan S, Murty M, Pilon K,(2004). Products containing bitter orange or synephrine: suspected cardiovascular adverse reactions, Can Med Assoc J, 171: 993.
21. Babu KM, McCormick MA,Bird SB, (2005).Pediatric dietary supplement use- an update, Clin Pedi Aterernerg Med,6:85-92.
22. Desbrow B M. (2007). Well-trained endurance athletes knowledge, insight and experience of caffeine use . International Journal of Sport Nutrition and Exercise Metabolism, 17(4) :328-339.
23. McDuff DR, Baron D, (2005). Substance use in athletics: a sports psychiatry perspective, Clin sports Med, 2005, 24: 885-897.
24. O'Connor PJ, Mod RW, Broglio SP, Ely MR, (2004). Dose-dependent effect of caffeine on reducing leg muscle pain during cycling exercise is unrelated to systolic blood pressure, PAIN, 109 (3): 291-298.
25. McClaren, SR, et al, (2003). Low dose of caffeine reduce heart rate during submaximal cycle aerometry, Medicine & Science in sports & Exercise,35(5) Supplement I pS277.

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