Available online at www.sciencedirect.com

ScienceDirect

Procedia Social and Behavioral Sciences 15 (2011) 2092–2095

Procedia Social and Behavioral Sciences

WCES-2011

The effect of caffeine on some cardiovascular factors in male student athletes

Davar Rezaimanesh [a] *, Parisa Amiri-Farsani [b], Eidy Alijani[c]

[a] *Khorramshahr Marine Science and Technology University, Khorramshahr, 6419947175, Iran*
[b] *Islamic Azad University Abadan branch, Abadan, 6419947175, Iran*
[c] *Islamic Azad University Karaj branch, Ahwaz, 6139646546, Iran*

Abstract

The purpose of this study was to examine the effect of caffeine on some cardiovascular factors and endurance exercises in male student athletes. Thus, 45 subjects with an average age of 20-28, height of 163.4-182.5 centimetres, and weight of 59.9-73.9 kg were matched into three groups as follows: experimental (1) Taking caffeine one hour before exercise (OHBE), experimental (2) taking caffeine three hour before exercise (THBE), and control group taking placebo. Descriptive statistic and One-Way Analysis of variance, dependent t, and follow-up Tukey test at (p= 0.05) were used to analyze data. The results showed that there were a significant difference between heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), blood glucose (BG) and time of endurance performance (TEP) in experimental groups and control group.

Keywords: cardiovascular factors, athlete, endurance exercises, caffeine, performance time,

1. Introduction

Caffeine is a popular material in the society that athletes use it for their physical preparation process and for contests. But the admissible amount of this material shouldn't exceed 12µg/ml (Ronald, J. Maughan. 2002). During last years, many researches are carried out to understand how caffeine consumption could influence cardiovascular factors during and after doing sport exercises. This researches show that caffeine consumption could influence on some cardiovascular factors .Some of these cardiovascular effects which are related to caffeine consumption are due to the secretion of enzymes which influence the cell internal transmitters as cAMP. The recent studies show that caffeine could influence calcium ion movement through muscle and neurons cells. This influence could promote individual hypertension.

The effects of methyl xanthenes in blood circulation system are complex and in some cases contrastive. The result of these effects is often related to the time, amount, and the using interval. In addition to the influence of caffeine on brainstem, it has a direct influence on blood vessels and heart tissues. In susceptible individuals, drinking some cups of caffeine daily can lead to arrhythmia. Groups of researchers believe that caffeine consumption is influencing the different systems and mechanisms of the body and cause delay in exhaustion during long-time exercise (endurance) in both humans and animals (Davis, J. M., Bailey, S. P. 1997).

It is supposed that caffeine in addition to increasing the time of doing activities decreases the lactate level. With caffeine consumption, the glycogen catabolism level decreases and the fat acid transfer is promoted. Some of the

* Davar Rezaimanesh. Tel.: +989166343603; fax:+ 98 632 4332409
E-mail address: davarrezaee@yahoo.com

1877–0428 © 2011 Published by Elsevier Ltd. Open access under CC BY-NC-ND license.
doi:10.1016/j.sbspro.2011.04.060

researchers believe in the tonic effects of caffeine, and during endurance exercise it leads to increase in fat oxidation and decrease glucose oxidation. According to their notion, caffeine consumption prevent any exhaustion and in turn resulted in performance promotion during endurance activities (Motl and et al, 2003). On the other hand, the caffeine tonic nature could be explained with metabolic theories (increase of fat oxidation during performing endurance exercise), influence skeletal muscles (controlling enzyme activity ATPase, k^+ and Na^+ movement) and effect some parts of CNS (Giebrecht and et al, 2010).

Athletes often have a tendency to try everything that seems to improve their performance. According to what is mentioned, athletes especially those who are elite, in order to succeed in important international competitions need to use all admissible feasibilities and what they required as nutrient or food supplements. But when these tonic materials are used irregularly and without any authentic reference, they will be so dangerous for athletes' health, and sometimes it leads to their death. One of those systems which is influenced by stimulants consumption, is cardiovascular system. So, in the current research, it is tried to study the effects of caffeine consumption in one hour and also three hours before endurance exercises on some of cardiovascular factors and the performance time of endurance activity among male athlete students.

2. Method

2.1. Participants

This research is categorized as "applied" and was conducted with a semi-experimental design. All the male athlete students of the Ahwaz Shahid Chamran University make up the Statistical population (N=254). Among these, 74 students participated in this research voluntarily. In order to evaluate Vo_2max, a Monark bike (model 894E) and Alstead test were used and 45 of the subject with Vo_2max between 40 to 50 ml $.kg^{-1}. Min^{-1}$ were randomly chose and again, randomly divided into three groups, each 15 as follows:

2.1.1. One-hour-before-exercise (OHBE) group: The subject took 5 mg/kg caffeine dissolved in water one hour before post test.

2.1.1.1. Three-hour-before-exercise (THBE) group: The subject took 5 mg/kg caffeine dissolved in water three hour before post test.

2.1.1.1.1. Control group: The subject took placebo before post test.

2.2. Measurements

After administrating pre and post test, a blood sample (2 ml) was taken from the subjects for examining blood glucose. Also, heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), blood glucose (BG), time of endurance performance (TEP) were measured immediately after pre and post test administration.

2.3. Procedure

After a brief warm-up session, subjects began training on the simple bike (model W) with initial resistance of 75w. 50w Resistance was added after 4 minutes. This was repeated for three more times (resistance 275w). Then after every 1 minute 30w of resistance was added until subjects reached exhaustion threshold (Bell, D. G., McLellan, T. M. 2002).

2.4. Statistical Analysis

All statistical analysis was accomplished using SPSS (ver 16). The one- way variance analysis, Tukey follow-up test and t-test, correlation of P=0.05 were used.

3. Results

The findings of this research presented in table (1). They are indicated that caffeine consumption significantly influences on heart rate (HR) in experimental groups ($P<0.05$). The tukey follow-up test indicate that there isn't any

significant correlation between heart rate (HR) in a group of doing exercise one hour before (OHBE) and three hours before doing exercise group (THBE).

The research results also indicate that the caffeine consumption influences subjects systolic blood pressure (SBP) ($P<0.05$) and their diastolic blood pressure (DBP) ($P<0.05$) significantly, but this differences isn't significant between the practical groups. Examining the result of this research indicate that caffeine consumption significantly influences the blood glucose (BG) ($P<0.05$) in subjects, but the Tukey follow-up test shows no significant difference between practical groups. These results also indicate that the caffeine consumption has a significant influence on the time performance of the endurance activity ($P<0.05$).The tukey follow-up test also show the significant relationship between performance time (TEP) of the endurance activities in practical groups, and this time is more in the group of on hour before exercise.

Table 1: Mean & standard deviation of variables in experimental and control groups.

variables	*Pre test*	*Post test*
HR		
OHBE group	167.6 ±7.6	172.6±5.4
THBE group	163.2 ±5.6	169.4±4
Control group	166/5±8.7	166.6±7.5
SBP		
OHBE group	16.7±.85	17.3±.76
THBE group	16.5±.81	17.1±.43
Control group	15.9±.86	15.8±.83
DBP		
OHBE group	8.1±.44	8.2±.39
THBE group	7.9±.35	8.1±.41
Control group	8.5±.44	8.4±.38
BG		
OHBE group	68.8±4.6	73.1±5.5
THBE group	70.3±5.2	73.6±5.2
Control group	71.3±5.4	68.1±3.9
PT		
OHBE group	19.2 ±2.1	23.3±2.3
THBE group	19.0 ±2.2	20.6±2.4
Control group	18.6 ± 2	18.6±2.1

4. Discussion & Conclusion

The results of this research show that caffeine consumption has a significant influence on the subjects' systolic pressure, but the Tukey follow-up test indicate that there isn't any significant difference between the group of three hours before exercise and the control group. Increasing systolic pressure in a group of one hour before exercise might be due to inactivity of intercellular transmitters as cAMP because of high caffeine concentration in the blood. The increase of calcium ion Ca^{++} transferring is another factor that is resulted by caffeine consumption. The research results of Lindinger and et al (1993), Tarnopolsky and et al (2000) approve this influence of caffeine, where as the other results as what is obtained by Bell, D. G., McLellan, T. M. (2002) and Awaad, A. S and et al (2010) do not approve any increase in the diastolic pressure.

The result of this research shows that the caffeine consumption leads to increase in diastolic pressure and also heart rate in both groups. One of the probable results for it might be increase in Ca^{++} movement, nor epinephrine synthesis and also increase in the transferring speed. The results of the current research are consonant with the results of researches carried out by Tarnopolsky & Cupido (2000); Lindinger and et al (1993). But they are inconsonant with the findings obtained by Bell, D. G., McLellan, T. M. (2002); Awaad, A. S. and et al (2010) that deny any increase in the diastolic pressure. Also this research finding is consonant with findings of Bell, D. G., McLellan, T. M. (2002); Bell, D. G. et al (2001) regarding to the subsequent increase in the blood glucose after caffeine consumption, that this might because of the increase in fat oxidation pathway due to caffeine consumption, but again these findings aren't consonant with Ping, W. C. and et al (2010).

On the other hand, this research results indicate that the caffeine consumption increase the time of performance in one hour before and also three hours before group, so that this increase is more considerable in one hour before

group. The result of more influence of caffeine consumption on an hour before group referred to the time of caffeine absorbent. As the maximum caffeine plasma concentration is observed between 30-60 minutes after its take, so the time of performance in one hour before group might be more than the other groups. The tonic effect of caffeine, on the other hand could be due to more calcium secretion in the final stage of exercise, and increase in Na^+ and ATPase. The result of this research is consonant with the increase in the performance time of endurance exercise after caffeine consumption in the research being done by Ping, W. C. and et al (2010); Doherty, M. Smith, P. M. (2004); Doherty, M. Smith, P. M. (2005); Gregory, R. and et al (2002); Bell, D. G. and et al (2001) but they are inconstant with findings of Kylie, j and et al (2003) and Woolf, K. And et al (2009).

However, the results of this research indicate that caffeine consumption in interval of one hour to exercise could increase heart rate, diastolic blood pressure, systolic blood pressure, blood glucose and also improve the time of performance for endurance activities in athletes.

References

Ronald, J. Maughan. (2002). Nutrition in Sport.(1rd ed). Blackwell Science Ltd, (chapter 28).

Davis, J. M., Bailey, S. P. (1997) possible mechanisms of control nervous system fatigue duringexercise. Medicine and science in sports and exercise, 29, 45-57.

Davis, J. M., Zhao, Z., Stock, H. S., Mehl, K. A., Buggy, J., Hand, G. A. (2003) central nervous system effect of caffeine and adenosine on fatigue. Am. J. physic, 284, 399-404.

Doherty, M., Smith, P. M. (2005). Effects of caffeine ingestion on rating of perceived exertion during and after exercise: a meta-analysis. Scand.j.Med. Sci. Sports, 15, 69-78.

Doherty, M., Smith, P. M. (2004). Effects of caffeine ingestion on exercise testing: a meta-analysis. Int J Sport Nurt Exerc metab, 14, 626-46.

Bell, D. G., McLellan, T. M. (2002). Exercise endurance 1,3, and 6 h after caffeine ingestion in caffeine users and nonusers. J Appl physiol, 93, 1227-1234.

Motl, R. W., O'Connor, P. J., Dishman, R. K. (2003). Effect of caffeine on perceptions of leg muscle pain during moderate intensity cycling exercise. J Pain, 4, 316-21.

Cox, G. R., Desbrow, B., Montgomery, P. G., Anderson, M. E., Bruce, C. R., Macrides, T. A., Martin, D. T., Moquin, A., Roberts, A., Hawley, J. A., Burke, L. M. (2002). Effect of different protocols of caffeine intake on metabolism and endurance performance. J Appl physiol, 93, 990-999.

Bell, D. G., Jacobs, I., Ellerington, K. (2001). Effect of caffeine and ephedrine ingestion on anaerobi exercise performance. Med Sci Sports Exerc, 33, 1399-403.

Conway, K. J., Orr, R., Stannard, S. R. (2003). Effect of a divided caffeine dose on endurance cycling . Performance, post-exercise urinary caffeine concentration, and plasma paraxanthine . J Appl physiol, 94, 1557-1562.

Lindinger, M. I., Graham, T. E., Spriet, L. L. (1993). Caffeine attenuates the exercise –induced increase in plasma (k^+) in humans. J. of applied physiology, 74, 1149-1155.

Tarnopolsky, M., Cupido, C. (2000). Caffeine Potentates low frequency skeletal muscle force in habitual and nonhabitual caffeine consumers. J Appl Physiol, 89, 1719-24.

Awaad, A. S et al.(2010). The Effect of Four Coffee types on Normotensive rats and Normal/Hypertensive Human Volunteers. Phytother Res, 10.1002/ptr.3333.

Giesbrecht, T., Rycroft, J. A., Rowson, M. J., De Bruin, E. A. (2010). The combination of L-theanine and caffeine improves cognitive performance and increases subjective alertness. Nutr Neurosci, 13, 283-90.

Ping, W. C., Keong, C. C., Bandyopadhyay, A. (2010). Effects of acute supplementation of caffeine on cardiorespiratory responses during endurance running in a hot & humid climate. Indian J Med Res, 132, 36-41.

Woolf, K., Bidwell, W. K., Carlson, A. G. (2009). Effect of caffeine as an ergogenic aid during anaerobic exercise performance in caffeine naïve collegiate football players. J Strength Cond Res, 23, 1363-9.