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Ido Movement for Culture : journal of martial arts anthropology... 11/3, 42-46

2011

"IDO MOVEMENT FOR CULTURE. Journal of Martial Arts Anthropology",
Vol. 11, no. 3 (2011), pp. 42–46

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Effect of a single session exercise done twice a day on plasma lipids, lipoproteins, immunoglobulin and cortisol in elite karatekas

Submission: 05.09.2010; acceptance: 07.01.2011

Key words: physiology, circadian rhythm, immunoglobulin, cortisol, karate

Abstract

Introduction: There is a large body of research showing that aerobic based physical exercise has an effect on plasma lipid and lipoproteins. Relatively little attention, however, has been directed toward the lipid andlipoproteins responses to a single session of exercise in athletes. Furthermore, studies have shown that our bodies follow a daily cycle called the circadian rhythms, which regulate everything from body temperature, metabolism, blood pressure, hormone secretion and performance. Thus, the aim of this study was to examine whether a single session of exercise at different time of day affected lipid andlipoproteins levels before and after maximal karate exercise.

Methods: twenty karate athlete (mean (SD) age 23 (3.4) years) volunteered to participate in the study and divided to trial and control groups. A trial group, with 36 hours between test sessions, performed two identical training sessions with %70-90 reserve heart rate at 07 and 19 hours in the same indoor place. plasma samples were taken pre and post exercise in all subjects.

Results: significant decrease observed in the afternoon VLDL and TG and increase HDL in posttest versus pretest ($P<0.05$). Trial and control group comparison showed significant difference in posttest of TC and LDL ($P\leq0.05$).

Conclusion: These results suggest that a single session exercise affect cortisol, immunoglobulin, lipid andlipoproteins with circadian variation in some variables.

Introduction

Circadian changes involved in physiological processes of athletic function have been studied a lot for 20 years. In the recent studies, changes in circadian rhythm of rest state in metabolism variables (oxygen and carbon dioxide consumption rate), ventilator responses and cardio respiratory (minute ventilation, heart rate, cardiac output, blood pressure), temperature adjustment variables (central temperature of body and skin, blood circulation) and hormone secretion (cortisol, catecolamines) are observed [Atkinson, Speirs 1998; Drust *et al*. 2003; Drust *et al.* 2005; Imamura *et al.* 2000].

Depending on its type, athletic function (short term or long term) may be done at different times of a day [*Reilly et al.* 2004]. Despite these findings, researchers believe that there is evidence showing that capability of athletic function is the highest in the evenings and early at night, that is, when the central temperature of body and metabolism is close to maximum [Drust *et al.* 2005]. In their last research, Salesi and Keshavarz [2006] asserted that most people experience the lowest temperature of body one to three hours before getting up in the mornings and the highest temperature at the end of the evening. They showed that power is 5% more around noon [Salesi, Keshavarz 2006].

Aerobic capacity and aerobic function increase 4% and 5% in the afternoon, respectively [Hill 1999]. This may not be that important for a beginner, but it is of high importance for a professional athlete.

On the other hand, Dimitriou *et al.* [2002] believe that morning exercise may infect athletes. Conducting a research on 14 professional swimmers, they found that cortisol hormone is the highest while IgA has the lowest degree. cortisol makes the immunity system weak but IgA helps removing the infection of the body. Therefore, they concluded that athletes are more in danger of infection if they do intense exercise in the morning [Dimitriou *et al.* 2002]. Of course, other researchers disagree with this view. For instance, Salesi and Keshavarz [2006] believe that professional athletes exercise when they feel their bodies are ready. They know their bodies well and realize that when their physical and spiritual circadian rhythm is in the highest condition. They believe that most people can select their own exercise time and they exercise when they are in their best condition [Salesi, Keshavarz 2006].

Because athletic competitions have become intensive during the recent years, karatekas like the athletes of other fields, spend many hours a day exercising under constraint, to improve their athletic function. Increase in exercise hours of a day and decrease in recovery time may prevent physiological variables to reach the same amount as before the exercise. So, it is likely that athlete encounters weakness in immunity response and increased physical and spiritual stress [Mackinnon *et al.* 1993; Salesi, Keshavarz 2006].

The review of study shows that most studies conducted so far deal with circadian rhythm in different indexes of muscular function, physiological function at rest, and reaction to mild or intense exercise, and blood factors, particularly lipids and bloodlipoproteins that are main factors of cardiovascular dangers are studied less. It is said that marathon exercises can affect lipids' profile by changing the intravascular enzymes' activity. Results of sport studies on blood lipids are different. Almost half of the reports show positive effect of sport on lipids and the others repot converse or changeless results [**Weise** *et al.* 2005]. Blood lipids' response to a one-session exercise shows decrease in TC, LDL, TG and increase in HDL is many studies. However, these changes are not clearly identified. Also, circadian changes in blood lipids ate not studied yet. As such, this study aims at investigating the effect of exercise time on thickness rate of IgA, cortisole and blood lipids.

Method

Subjects

The subjects were 20 elite karatekas, with an average age of 23±1.7 years and athletic experience of 7±2.2 years, who voluntarily took part in the study. The subjects were divided to two experimental (N=10) and control (N=10) group at random. They were asked not to have any sport activity at least 48 hours before the experiment and follow their regular food and sleep programmeme.

Study project

The experimental group took part in a programmeme similar to karate exercise for an hour in 70-90% heart rate reserve's limit, in three different days (every three days), and in two different hours (7 a.m. and 7 p.m.). The exercise programme included 10 minutes of warm-up, 10 minutes of kicking exercise, 10 minutes of punches exercise, 10 minutes of compound exercise, 5 minutes of match and 5 minutes of cool-down. Between each stage, the athletes took a 2-minute active break. Control group took a rest at the time and place of the study. The exercise programme was performed similarly every two days and under the supervision and performance of an international karate coach.

Data collection procedures

On the day of the first examination, first, all of the subjects were weighted with the least clothes and by weighting machine with 0.1% kg accuracy, and then their height was measured without shoes while they had normally held their breathe. Skinfold method rate of the subjects was measured on three areas of triceps, iliacus, and abdominal using Caliper. All measurements were done by a naked person on the right. The subjects' lipid percentage was calculated by Jackson and Pollock formula [Nieman 1990].

Bleeding was done by the lab technician at the experiment place immediately before and after the exercise in both sessions. 5cc of blood was taken from the subjects' right hands and was kept at -10c after transferring to the lab.

Data analysis procedure

To analyze the data, descriptive statistics (mean, standard deviation, the most and the least amount) and inferential statistics (T. test) was used in this study to compare the means before and after the exercise programme.

Results

Table 1 shows the descriptive data of the subjects. Lipid and lipoprotein rate of experimental group as well as the effect of the exercise sessions and the measured time on IgA and cortisol thickness before and after the exercise programme are presented in table 2 and 3.

Tab. 1. Characteristics of the subjects of the study

Group	Statistics variables Variables	Mean	Standard deviation	Maximum	Minimum
Experimental Group	Stature (cm)	177.8	5.2	192	167
	Scale (kg)	72.8	7.6	99	55
	BMI	22.3	3.4	28.4	18.25
	Fat percentage	14.9	4.7	18	10.3
Control Group	Stature (cm)	177.1	4.3	180	171
	Scale (kg)	67.6	5.9	86	56
	BMI	21.2	3.8	24.3	18.9
	Fat percentage	12.8	3.4	18	7.1

Tab. 2. lipid and lipoprotein rate of the experimental group

Indices Variables	Mean difference	Std.error difference	t	Sig (2-tailed)
Colstrol	6.60	5.79	1.14	0.26
LDL	7.75	4.68	1.65	0.11
HDL	8.05	3.03	2.66	0.01
VLDL	-8.15	3.66	-2.23	0.03
TG	76.65	31.94	-2.40	0.3

Tab. 3. Result of statistical analysis about the effect of the sessions and the measured time on Immunoglobulin A and cortisol

Indices Variables	Mean difference	Std.error difference	t	Sig (2-tailed)
IgA	-1.43	0.23	-0.62	0.54
cortisol	46.31	15.52	2.98	0.005

Ordinary characteristics of the subjects in different groups are shown in table 1.

Comparison between the morning and evening results of the experimental group illustrated that the sport activity done in the evening decreased VLDL and TG and increased HDL significantly after the programme ($p<0.05$).

Results demonstrated that the sport activity done in the morning had a significant increase in cortisol rate after the exercise programme.

Discussion and conclusion

The primary goal of this study was to investigate the effect of one session of karate exercise at different times of a day on IgA, cortisol, lipid and lipoprotein thickness of elite karatekas' plasma. Accordingly, 20 karatekas were chosen and divided into two control and experimental group. The results showed that exercise in the morning has caused a signification increase in cortisol thickness and has more positive effects on blood lipids in the evening (decrease VLDL and TG and increase HDL).

The results of this study are in line with most other studies done in circadian area and they state sport activities cause higher function in the evening than in the morning. Many of these studies believe that the reason is body temperature which is higher in the evening and at night and this may facilitate metabolism processes [Drust *et al.* 2003; Drust *et al.* 2005; Edwards *et al.* 2005; Hill 1999].

According to the results, one exercise session at two times (morning and evening) did not have a significant effect on IgA thickness. The literature of scientific evidence in this area shows different mechanisms to account for changes of IgA thickness. These mechanisms are: secretion rate of hormones such as cortisol, Beta Androphine, physical stress, psychological stress, decrease in saliva flow and insufficient exercise intensity [Gleeson 2000; Mackinnon *et al.* 1992]. The results of the present study are consistent with Dimitriou *et al.* [2002], Reid *et al.* [2001], Pyne [2000], McDowell [1991] and one probable reason of this consistency is the low exercise intensity, because, probably this pattern of activity blocks IgA secretion [Dimitriou *et al.* 2002; McDowell *et al.* 1992; Pyne *et al.* 2001; Reid *et al.* 2001].

Other findings of the research showed that exercise in the morning caused a significant increase in cortisol thickness. Regarding changes in cortisol thickness after bodily activities, different mechanisms are also set forth as following: hypothalamo-pituitary adrenal (HPA) stimulation, ACTH secretion and temperature of the center of the body, PH changes, sympathetic nervous system, hypoxia, lactate accumulation and mental stress [Buono *et al.* 1986; Deligiannis *et al.* 1993; Filaire *et al.* 1996; Kraener *et al.* 1989; Lac *et al.* 1997].

Kaciuba-Uściłko [1992] reported that by increasing the amount of daily exercise, cortisol thickness increases. Also, Kraemer *et al.* [1989] believe that cortisol thickness increases after continuous exercise [Kaciuba-Uściłko *et al.* 1992; Kraener *et al.* 1989].

The results of the present study are in line with that of Kaciuba-Uściłko [1992] and Rudolph [1998] and this consistency may be because of the equality of the exercises' average intensity [Kaciuba-Uściłko *et al.* 1992; Rudolph, McAuley 1998].

In their study on gymnasts, Daly *et al.* [1998] reported that low intensity of gymnastic programme caused no change on adrenalin function. Similarly, in their study on immature boys, Corral *et al.* [1994] observed no significant change in cortisol change after 30 minutes of aerobic activity [Corral *et al.* 1994; Daly *et al.* 1998].

However, the result of Kraemer *et al.* [1989] study is different from those of the present study. Of course, the difference may be because of intensity, duration, type and place of exercise, and the subjects' age [Kraener *et al.* 1989].

Lack of correlation between IgA and cortisol was another finding of the study. Lack of correlation may be due to different IgA and cortisol response to bodily activity. In the present study, IgA thickness did not change in the two mornings and evening sessions, while cortisol thickness increased. These findings are consistent with the results of Tharp *et al.* [1991] studies. Given that the mechanisms of IgA decrease is not completely identified yet, the results of this study shows no significant effect on IgA thickness [Tharp 1991].

In general, based on the findings, it can be concluded that the change in IgA is not as a result of exercise amount, but cortisol will change with increase in exercise amount. No change in IgA thickness after bodily activity in the evening demonstrates that exercise sessions with medium density may have no effect on function of immune system of an athlete and increased danger of infection.

In sum, circadian rhythm and its effect on athletic function is a multidimensional topic that should be addressed from different viewpoints and more studies are needed to find the appropriate time of exercise which produces the maximum efficiency for an athlete.

References

1. Atkinson G., Speirs L. (1998), *Diurnal variation in tennis service*, "Percept Mot Skills" 86 (3 Pt 2): 1335-8.
2. Buono M.J., Yeager J.E., Hodgdon J.A. (1986), *Plasma adrenocotropin and cortisol responses to brief high intensity exercise in humans*, "J Appl Physiol." 64: 1337-39.
3. Corral P.D., Mahon A.D., Duncan G.E., Howe C.A., Craig B.W. (1994), *The effect of exercise on serum and salivary cortisol in male children,* "Med Sci Sports Exerc." 1994 Nov; 26(11): 1297-301.
4. Daly R.M., Rich P.A., Klein R. (1998), *Hormonal responses to physical training in high-level peripubertal male gymnasts,* "Eur J Appl Physiol Occup Physiol." 1998 Dec; 79(1): 74-81.
5. Deligiannis A., Karamouzis M., Kouidi E., Mougios V., Kallaras C. (1993), *plasma TSH, T3, T4 and cortisol responses to swimming at varying water temperatures,* "Br J Sports Med." 1993 Dec; 27(4): 247–250.
6. Dimitriou L., Sharp N.C.C., Doherty M. (2002), *Circadian effects on the acute responses of salivary cortisol and IgA in well trained swimmers*, "*Br J Sports Med.*" 36: 260-264.
7. Drust B., Atkinson G., Reilly T., Waterhouse J. (2003), *The relevance of melatonin to sports medicine and science*, "Sports Med." 33(11): 809-31.
8. Drust B., Waterhouse J., Atkinson G., Edwards B., Reilly T. (2005), *Circadian Rhythms in Sports Performance,* "Chronobiology International", 22(1): 21-44.
9. Edwards J.B., Lindsay K., Waterhouse J. (2005), *Effect of time of day on the accuracy and consistency of the badminton serve*, "Ergonomics" 48(11): 1488-98.
10. Filaire E., Duché P., Lac G., Robert A. (1996), *Saliva cortisol, physical exercise and training: influences of swimming and handball on cortisol concentrations in women,* "Europ J of Appl Physiol & Occupational Physiol", 274-78.
11. Gleeson M. (2000), *Mucosal immune responses and risk of respiratory illness in elite athletes,* "Exerc Immunol Rev" 6: 5-42.
12. Hill D.W. (1999), *Effect of time of day on aerobic power in exhaustive high-intensity exercise,* "J of Sports Med & Physical Fitness", 36: 155-160.
13. Imamura H., Katagiri S., Uchida K., Miyamoto N., Nakano H., Shirota T. (2000), *Acute Effects of Moderate Exercise on Serum lipids,lipoproteins and Apolipoproteins in Sedentary Young Women*, "Clin and Exper Pharmacology and Physiology", 27: 975-979.
14. Kaciuba-Uściłko H., Kruk B., Szczypaczewska M., Opaszowski B., Stupnicka E., Bicz B., Nazar K. (1992), *Metabolic body temperature and hormonal responses to repeated*, "J Apple Physiol", 64: 26-31.
15. Kraener W.J., Fleck S.J., Callister R., Sllealy M., Dadly G.A., March C.M., Marchitelli L., Cruthirds C.H., Murray T., Falkel J.E. (1989), *Training responses of plasma beta endrophin, adrenocorticotropin and cortisol,* "Med Sci Sports Exerc", 21(2): 146-153.
16. Lac G., Pantelidis D., Robert A. (1997), *Salivary cortisol response to a 30 min submaximal test adjusted to a constant heart rate,* "J Sports Med Phys Fitness", 37(1): 56-60.
17. Mackinnon L.T., Ginn E., Seymour G.J. (1992), *Effects of exercise during sports training and competition on salivary IgA levels* [in:] A.J. Husband [ed], *Behavior and Immunity*, Boca Raton, pp. 169-77.
18. Mackinnon L.T., Ginn E.M., Seymour J. (1993), *Temporal relationship between decreased salivary Iga and respiratory*

tract infection in elite athletes, "The Austra J Med Sport" 25(4): 94-99.
19. McDowell S.L., Hughes R.A., Hughes R.J., Housh T.J., Johnson G.O. (1992), *The effect of exercise training on salivary immunoglobulin A and cortisol responses to maximal exercise,* "Int J Sports Med", 13(8): 577-580.
20. Nieman D.C. (1990), *Fitness and sports medicine: An introduction*, Human Kinetics Inc.
21. Pyne D.B., McDonald W.A., Gleeson M., Flanagan A., Clancy R.L., Fricker P.A. (2001), *Mucosal immunity, respiratory illness, and competitive performance in elite swimmers*, "Med Sci Sports Exerc", 33(3): 348-353.
22. Reid M.R., Drummond P.D., Mackinnon L.T. (2001), *The effect of moderate aerobic exercise and relaxation on secretory immunoglobulin A*, "Int J Sports Med", 22(2): 132-7.
23. Reilly T., Fairhurst E., Edwards B. *et al.* (*2004), Time of day and performance tests. Science and football V*, Routledge, London, pp. 275–279.
24. Rudolph A.D., McAuley E. (1998), *cortisol and affective responses to exercise,* "Journal of Sports Sciences", 16(2): 121–128.
25. Salesi M., Keshavarz M.J. (2006), *Effect of exercise on IgA, cortisol and lipids in elite athletes,* International congress of new perspective & innovations physical education & sport sciences, Tehran, Iran.
26. Tharp G.D. (1991), *Basketball exercise and secretory immunoglobulin A,* "Euro J of Appl Physiol and Occupational Physiol", 63.
27. Weise S.D., Grandjean P.W., Rohack J.J., Womack J.W., Crouse S.F. (2005), *Acute changes in blood lipids and enzymes in postmenopausal women after exercise*, "J Appl Physiol" 99: 609-615.

Wpływ pojedynczej sesji ćwiczeniowej wykonywanej dwa razy dziennie na poziom lipidów w osoczu, lipoprotein, immoglobuliny i kortyzolu wśród najlepszych karateków

Słowa kluczowe: fizjologia, rytm dobowy, immunoglobuliny, kortyzol, karate

Streszczenie

Wstęp: Istnieje dużo badań, które pokazują, że ćwiczenia aerobowe mają wpływ na lipidy w osoczu oraz lipoproteiny. Autorzy przytaczają opinie innych naukowców, którzy próbują stwierdzić, która pora dnia jest najlepsza do ćwiczeń. Według jednych badań są to godziny około południa, inni twierdzą, iż późne popołudnie, gdyż rano poziom kortyzolu jest najwyższy, podczas gdy IgA najniższe, co sprzyja infekcjom jeśli ćwiczenia odbywają się rano. Według kolejnej teorii sportowcy sami czują kiedy powinni odbywać ćwiczenia co wiąże się z ich indywidualnym samopoczuciem. Stosunkowo niewiele uwagi zostało poświęcone lipidowym i lipoproteinowym reakcjom zachodzącym w czasie jednej sesji ćwiczeń u sportowców. Ponadto, badania wykazały, że nasze ciała podlegają codziennemu cyklowi zwanemu rytmem dobowym, który reguluje wszystkim, poczynając od temperatury ciała, metabolizmu, ciśnienia krwi, wydzielania hormonów i wydolności. Stąd celem tej pracy było zbadanie, czy pojedyncza sesja ćwiczeń w różnych porach dnia wpływa na poziom lipidów i lipidoprotein przed i po maksymalnych ćwiczeniach karate.

Metody: 20 karateków (średnia (SD) wieku 23 lata) wzięło na ochotnika udział w badaniu. Cała próba badawcza została podzielona na grupę próbną i kontrolną. Grupa próbna mająca 36 godzin przerwy między testami wykonała dwie identyczne sesje treningowe z 70-90% rezerwą wysiłkową akcji serca pomiędzy godziną 7 a 19 w tym samym pomieszczeniu. Próbki osocza zostały pobrane przed i po ćwiczeniach od wszystkich osób.

Rezultaty: Zaobserwowano znaczny spadek VLDL po południu oraz wzrost HDL w badaniach przed i po testowych ($P<0.05$). Porównanie grupy próbnej i kontrolnej wykazało znaczne różnice w TC i LDL po testach ($P \leq 0.05$).