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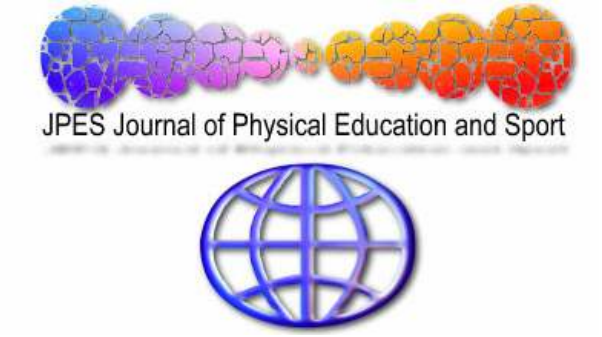

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ORIGINAL RESEARCH

THE EFFECT OF SPORT COMPETITION ON SALIVARY STEROIDS IN AMATEUR FEMALE KARATE ATHLETES

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Abstract

The purpose of present study was to investigate the impact of repeated competition on salivary cortisol and DHEA-S in amateur women karate athletes. We recruited 20 young elite female karate fighters [height 158 ± 7 cm (mean ± S.D.), weight 59.5 ± 10.9 kg, age 21.1 ± 3.0 years], who were placed first till fourth in the Iranian championship tournament. Five ml of unstimulated whole saliva was collected 30-min before and 5-min after first and last match in competition and analyzed for cortisol and DHEA-S concentrations. The results showed that participation in competition resulted in significantly increased saliva cortisol level ($p < 0.05$). The concentration of salivary cortisol increased throughout the competition ($p < 0.05$). Although the concentration of cortisol was decreased after a final competition, it was higher than resting values ($p < 0.05$). The concentration of salivary DHEA-S was not affected by competition ($p > 0.05$). Significant differences in salivary steroids were not different between winners and losers ($p > 0.05$). The results of present study show that salivary cortisol concentration is a suitable index for showing competing stress.

Key words: Cortisol; DHEA-S; Saliva; Karate; Women.

Introduction

Success in competition requires well-adapted physiological and psychological capacities to minimize the disruption of homeostasis and affect optimal decision making. Game sports which requires concurrently high levels of physical attributes and concentration, such as karate, are won and lost if either of these capacities are not operating optimally. The extent of physical and mental stress experienced during a game can be detected by the hormonal responses to competition. The scientific literature indicates that androgens and cortisol are the most sensitive hormones to these stresses and reveal the differences in their concentrations before, during and after participation [3,14]. With this in mind, it seems sensible that the hormonal responses to

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competition in winners and losers will be different, particularly prior to exercise. In the last three decades researchers have reported the increase in testosterone concentration in winners and the decrease its concentration in losers few hours after the competition and vice versa [6]. Others have reported no significant changes in blood testosterone [1,7,15,16]. Also, being the actual winner in competition may not be the main mediator of the hormonal response; perception of being winner may indeed change the testosterone concentration. Level of experience and ability (elite vs. non-elite) [10] and gender are the other effective factors [1] which alter the stress and androgenic hormone responses to competition. In women the concentration of testosterone is derived from dehydroepiandrosterone sulfate (DHEA-S) secreted in response to active hormonal axis in response to peripheral events such as fear and stress [14]. Therefore the purpose of the present study was to investigate the effect of participation in a first significant event on salivary cortisol and DHEA-S in amateur karateka women, and then compare the responses of the above-mentioned hormones between winners and losers.

Material and method

Subjects

All of the athletes in a national karate tournament were invited to participate in the study. During the first morning of competition, subjects were asked to fill a medical questionnaire and the aims and procedures of the study were described to subjects carefully and consent granted in writing. After the end of competition, data were collected from women who were the placed first to fourth in each of five weight categories. In total, 20 women [mean age 21.1 ± 3.0 year (mean ± SD), height 158.1 ± 7.3 cm and weight 59.5 ± 10.9 kg] who win the tournament (first until fourth place-getter) in the 50, 55, 60, 65 and >65 weight categories were selected as subjects. None of these subjects reported hormonal disorder, or use of any drug during the study, and all of them report normal menstrual cycle.

Competition

The karate competition from which subjects were recruited for the present study was a national competition for women in full contact style with five weight categories. Before each competition subjects use non-contact karate techniques for their warm up. Competition started at 8:30 a.m. and the duration of each bout was three minutes. The total competition duration was related to the number of persons that taking part in each weight category. The data collection sequence was showed in Figure 1.

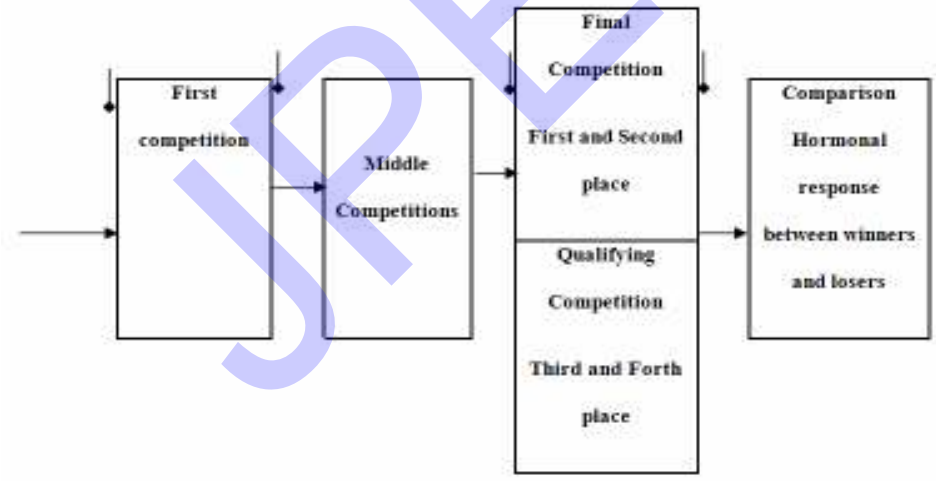

Figure 1. The experimental design of the study (Indicating saliva sampling). *Arrows* (↓) indicated where saliva samples were drawn

Saliva sampling and assaying

Before saliva sampling, the subjects rinsed out their mouths in order to remove any substances that may affect the hormonal measurements. The subjects were asked to drink 100 ml water to avoid dehydration, and then five ml unstimulated whole saliva was collected half an hour before and five minutes after the first and last bouts of competition. Subjects were instructed to allow saliva to dribble into the collecting tubes unaided by spitting. All saliva collections were taken whilst subjects were seated leaned forward with their heads down. Samples were transported in ice to the laboratory and were kept frozen at -20°C until use. On the day of testing,

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all samples were centrifuged at 3000 rpm for 10 min to remove mucins. The clear sample was transported into appropriate testing wells or tubes. Salivary cortisol and DHEA-S concentrations were measured by enzyme linked immunosorbant assay (ELISA). The kit for cortisol and DHEA-S were obtained from RADIM (Pomezia, Italy; sensitivity 5 ng/ml), and DRG Diagnostics (DRG Diagnostics, Germany; sensitivity 0.8 ng/ml) respectively. All assays were carried out in duplicate. Quality controls were included in all series of determination. All hormone samples were tested in the same series to avoid any variations between assays.

Statistical analyses

The normal distribution of all the data was confirmed by k-s test. Changes in salivary cortisol and DHEA-S concentration were compared using repeated-measures ANOVA and Greenhouse-Geiser epsilon (ε) used for correction of P values. Paired T-test with Boneferroni correction was done for additional post-hoc analyses. For comparing concentration of salivary hormones in winners and losers after the final match competition, independent samples *t*-test was used. An alpha level of 0.05 was used to determine statistical significance. All statistical analyses were performed using the SPSS program for Windows, version 15.0.

Results

Participating in karate competitions can change salivary cortisol concentration significantly ($F(3,57) = 8.05$, $p \leq 0.001$, $\epsilon = 0.851$, $\mu 2 = 0.298$). Paired *t*-testing showed that salivary cortisol concentration increased significantly before the final match in comparison to resting value. Although after the final match cortisol concentration decreased somewhat, it was also significantly higher than resting concentrations (Figure 2, panel A). Moreover, participation in competition did not alter the saliva concentration of DHEA-S ($F(3,57) = 1.21$, $p \leq 0.312$, $\varepsilon = 0.872$, $\mu 2 = 0.60$ (Figure 2, panel B). Comparison of salivary samples between winners and losers after final or qualifying matches showed that there were no significant differences for cortisol and DHEA-S concentrations ($p > 0.05$) (Figure 3 panel A and B).

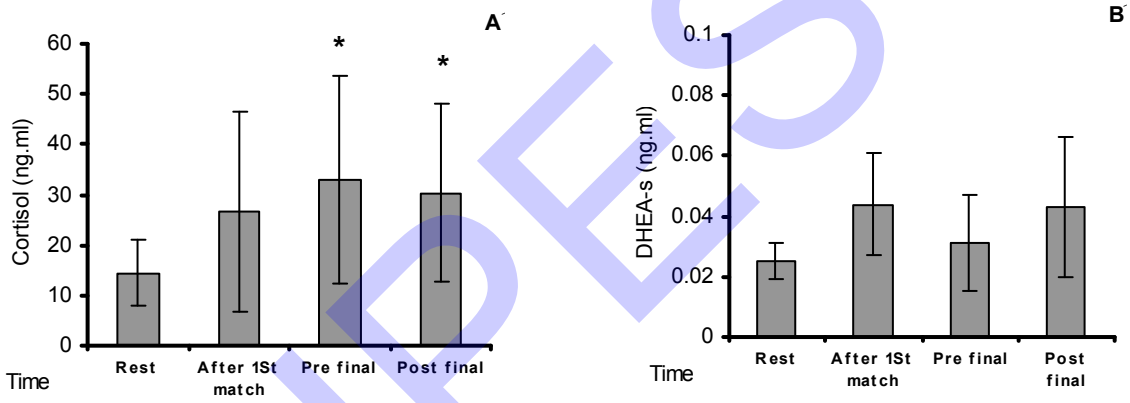

Figure 2. Concentrations of saliva cortisol (ng/ml)(A) and DHEA-S (ng/ml) (B) at rest, after 1st match, pre and post final match.* Denotes statistical differences from Rest. Values are mean±Std.

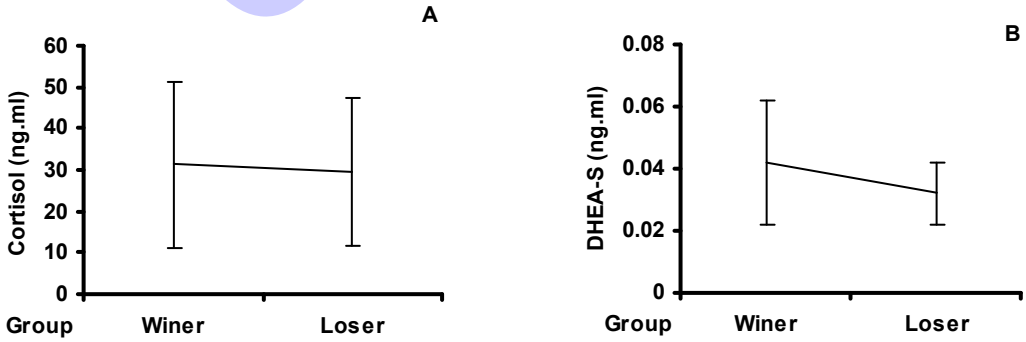

Figure 3. Concentrations of saliva Cortisol (ng/ml) (A) and DHEA-S (ng/ml) (B) in winners and losers. Values are mean ± SD.

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Discussion

The main result of this study was that participation in karate competition significantly alters the saliva cortisol concentration in women. Saliva cortisol concentration increased before final match as compared to resting values and remained high until competition finished. Whilst perhaps not surprising, we believe this to be the first description of the stress hormone response to women karate players before and during competition.

Important stimuli of cortisol secretion are blood glucose concentrations and exercise intensity. The former was undoubtedly high given the nature of the competition. Anaerobic exercise metabolites such as lactate, decrease of pH, and hypoxia are stimuli of hypothalamus-pituitary- adrenal axis. In the present study in each phase of the three minute match anaerobic energy system was likely dominant. It seems that subjects tolerated high physical stress and the intensity of exercise exceeded the threshold of cortisol secretion. We had no measure of the blood glucose concentrations, but it is likely that this was not low as has been shown in prolonged constant intensity exercise [11]. By nature of competition, participants not only experienced physical stress but they also likely experienced a high level of psychological stress. Another important stimulus for cortisol secretion is mental stress. Whilst some exercises such as shooting induce low physical stress, cortisol concentrations are elevated [8]. Deinzer et al (1997) were test the effect of three free jumps on cortisol secretion and a noteworthy observation was that cortisol concentrations decreased after the 3rd jump that was due to the accustomedness of subjects of jumping stress [21]. This suggests that experience in a stressful environment, such as competition experience, can alter the stress response.

We tested the hypothesis that the stress hormone response to competition would be different in women of different levels of ability; measured by their success in the event. This however did not change, probably because for these women, they were all naïve to regional (higher level) competition and so all experienced similar preparatory mental stresses. The present study showed that a DHEA-S concentration was not different at any point of competition and between winners and losers. DHEA-S is a precursor hormone for androgens that change to male sex hormones in the adrenal glands. As such, it is the main modulator for biosynthesis of androgens and estrogens in human sex glands and adrenal glands. However physiologic levels of testosterone are very low in females and in present study the saliva concentrations was measured; in this body fluid, concentrations are very low. However, as adrenal concentrations of androgens are similar in both sexes, in the present study DHEA-S was measured instead of testosterone. Filaire and co-workers [5] reported that saliva DHEA-S is a more suitable index than testosterone for indicating the androgenic response to training in females. However, others did not report a significant difference in saliva DHEA-S concentrations after volleyball and handball competitions in female athletes [4]. Our results are similar to the results of above studies. Together, results indicated that the cortisol response to competition is different from the androgen response. Previous studies have indicated that winners have higher concentrations of testosterone than losers [7,13]. The mechanisms of these differences between winners and losers is not clearly defined, but there is an important theory that social status coould plays a role [9,12]. In this study the competition didn't have any prize for the winners and this could have impacted upon the perceived effects on social status. Thus, perhaps winning or losing in this competition was not important. Much more research needs to be performed in this area, particularly in women. Finally, the attitude of players and the importance of competition for them cannot be underestimated. It could be possible that the players were more interested in competing alone and did not have a strong motivation for winning.

Conclusion

The results of this study indicated that participation in karate competition can change saliva cortisol concentration in women but it does have a significant effect on salivary DHEA-S concentrations. This suggests that glucocorticoids are more sensitive to competition compared with the androgenic response; but that the saliva cortisol concentration is a suitable index for define competitive stress.

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