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Acute and chronic effect of interval and continues resistance training on salivary IgA and cortisol levels in active young women

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Abstract

The purpose of this study was to investigate the Acute and chronic effect of interval and continues resistance training on salivary IgA and Cortisol in active young women. Twenty one healthy female's participated voluntary in this study, Following anthropometric measurements session and determination of 1-RM, all subjects were randomly assigned to interval and continues training groups and a control one (each group n=7). Training groups performed 8 weeks of continues and interval strength training with progressive manners, while the control group did not participate in any exercises. Two acute resistance exercises performed before and after 48h of the last training session, salivary samples were taken before, immediately and after 1h recovery in acute sessions for training groups, but for control group only resting salivary samples before and after training periods were taken. Repeated measure ANOVA with between groups factors have been used for comparing training groups. If significant difference were found, Bonforoni post hoc test were used. Total body mass and percentage of body fat were not significantly changed either in control or training groups after training periods. Resting s-IgA training groups were increased significantly in comparison with control group (P=0.034), but cortisol had no changes. Also Interval and continues strength training to have no-significant effects upon the salivary IgA and cortisol acute responses. The data from the present study suggested that s-IgA and cortisol responses to low intensity progressive interval and continues resistance training had no different in acute responses to strength exercise, and different protocol with high intensity and volumes may be needed for making considerable differences in s-IgA and cortisol levels.

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Introduction

The immune system protects surfaces of respiratory and gastrointestinal tracts that exposing to the environment by mucous membranes and it's considered as the first barrier for the microorganism causing upper respiratory tract infection (URTI) in many situation especially during exercise and training programs (Gleeson 2006; Medzhitov 2007). In endurance type training URTI is reported as the common post competition problems that had dose-response relationship with pre-race training volume and yearly training distance (Bermon 2007; Nieman 2007). Salivary Immunoglobulin A (S-IgA) is the main Immunoglobulin that had been found in mucosal secretion and it's the most important part of mucosa that prevent antigens and microbes sticks to the epithelium, and URTI is very common in athlete especially after heavy and long-term training (Fahlman and Engels 2005; Neville, Gleeson *et al.* 2008). One of important reason for URTI prevalence that proposed is Salivary IgA suppresses as an important barrier against infection in mucosal layers of mouth (Arazi and Azizi 2011). McDowell and *et al* (2008) studding Effect of running on sIgA and Cortisol Responses to Maximal Exercise and their findings indicated that the s-IgA response to maximal exercise was unaffected by moderate (70%of VO_2max) to heavy (86% of VO_2max) training (McDowell, Hughes *et al.* 1992; Vahid, Valiollah *et al.* 2009). Mackinnon and *et al* (1993) reported IgA concentration and secretion rate reduction by intense interval exercise, and suggest that mechanism contributing to URTI in elite athletes is exercise-induced changes in IgA output (Traeger Mackinnon, Ginn *et al.* 1993). Increase in circulating stress hormones like cortisol that had negative correlation with IgA is also reported as suppressor of immune system (Webster Marketon and Glaser 2008). Low levels of IgA or chronic deficit is correlated with increased risk of URTI, this condition permit pathogens to inter body tissue via epithelial layer (Gleeson, Bishop *et al.* 2012).

Although current information's about s-IgA and cortisol responses to exercise training are in conflict, but this different data may due to different training protocols, subjects, and sex (Gleeson 2006). Also literature review about endurance training type and immune system response are considerable(Gleeson 2006; Nieman 2007; Vahid, Valiollah *et al.* 2009) but the research about strength training program and immune system adaptation are rare(Pedersen and Hoffman-Goetz 2000).

Resistance training had ability to acute increase in cortisol levels and salivary cortisol levels cause suppression of s-IgA (McDowell, Hughes *et al.* 1992). Strength training previously was common among elite athlete and men's population but today this type of training had widespread popularity in general, especially among women (Kraemer and Keijo 2008). Strength training has different types and mode that each one had beneficial use and cause special adaptation(Kraemer and Ratamess 2004). For example continuous resistance exercises are types of exercises which are usually executed with a constant intensity (typically with a moderate intensity) and are performed continuously, during exercise. In contrast, interval resistance exercises are conducted with two different intensities (intense and low-pitched) and in an interval manner (Arnardóttir, Boman *et al.* 2007). Because of important mechanism that control immune systems in response to training and lack of study about interval and continues resistance training effects on immune system among women, the question that arises is; whether intensities (in as much as possible) and span of these two types of resistance exercises are controlled uniformly, have the same effects on acute and chronic response of salivary IgA and cortisol?

Material and methods

Subjects

Thirty six healthy female's participated voluntary in this study, their properties have been represented in Table 1. All subjects completed a medical questionnaire and examine by physician to ensure that they were free of drug and medication and had no history of endocrine disorders or diabetes before and during this study. The University's Ethics Committee of Islamic Azad University (Central Tehran Branch)

initially approved the experimental procedures and study protocols that performed in accordance with the 59th Helsinki Declaration (Seol, Korea, October 2008) , and were fully explained to all subjects, and a written consent form was signed after having read and understood the details of the experiments. All subjects were physically active but had not been involved in any previous structured resistance training programs in past 1 year.

Anthropometric measurements and 1-Reapeted Maximum (1-RM)

In familiarization session a week before starting training, beside introduction of the subjects with resistance movements, anthropometric properties, height, weight, body fat percentage and also 1RM were measured. Height was measured to the nearest 0.5 cm without shoes using a measuring tape attached to a wall, and Body mass and total body fat mass were measured using Segmental Body Composition Analyzer (X BIA 500, South Korea) with correction for light indoor clothing. Body mass index (BMI) was calculated as body weight in kilograms divided by height in meters squared [BMI=weight (kg)/height (m^2)]. Following familiarization session, subjects were asked to report to the laboratory for an additional session designed to determine 1RM for seven exercises including upper and lower body parts. The heaviest weight successfully lifted using the correct technique for each exercise was considered as the 1RM (Bryanton, Kennedy *et al.* 2012).

Experimental design

Following anthropometric measurements session and determination of 1-RM, all subjects were randomly assigned to 2 experimental groups: continues strength training group (n=8), interval strength training group (n=8), and control group (n=7). Two subjects were eliminated, because of their personal reasons. Training groups performed 8 weeks of continues and interval strength training with progressive manners, while the control group did not participate in any exercises and has their daily life activity. Two acute resistance exercises performed before and after 48h of the last training session, salivary samples were taken before, immediately and after 1h recovery in acute sessions for training groups, but for control group only resting salivary samples before and after training periods were taken. To control the possible effect of diet and physical activity, all sampling took place after an overnight fast and also all subjects were asked to not have strenuous physical activity 48h before sampling. The exercise training groups trained at the same time of day, throughout the study and care was taken to ensure that the environmental conditions (ambient temperature, 22-23 °C and relative humidity, 50-55%) were identical during all exercise sessions. During the training, all subjects were under direct supervision and were instructed on how to perform each exercise.

Trainings program

Resistance trainings schedule consisted of three sessions per week for 8 weeks and duration of each session was 63 min (including 10 min warm-up, 47 min main exercise and 6 min cool-down). In this schedule, a percentage of a maximal repetition and speed execution considered as intensity and mass of training. Exercises loads were the same for continuous and interval resistance exercises. The progressive implemented load was in a manner that during these 8 weeks, the subject performed training program with 20%, 25%, 30%, 35%, 40%, 45%, 50% and 55% of a maximal repetition for the first week to the last one, respectively. The resistance trainings were designed in circular manners and 2 schemes of continuous and interval procedures. Each circle contained: latissims pull down, leg extension, triceps pushdown, leg curl, bench press, and back squat, which order of execution was the same as ~~what~~ mentioned. Duration of each station considered as 2 min and 30 sec, which executed with different speeds in continuous and interval exercises. The continuous training group performed 2 min and 30 sec of each station with speed of V, continuously. And, the interval one carried out 10 sec with speed of 2V and 20 sec with speed of $^1/_2$V intermittently, to the ending of 2 min and 30 sec of each station. Speeds of movements were been controlling by metronome.

Rest intervals between 2 successive stations and circles considered as 1 min and 2 min, respectively. Two circles were considered in each exercise session. Both of before and after the trainings period resistance activities, which counted as the test session and samples collecting one, respectively, were done in the same mentioned figures and with 20% of a maximal repetition. Each subject started and finished her entire activity sessions in particular times. These times are the same for all of her exercise sessions. The subjects of control group didn't performed any sport and physical exercise and proceeded their daily and usual activities.

Salivary Samples Collecting and Hormonal Analysis

Before, immediately and 2 hr after the first test (48 hr before trainings) and the p**ost** test (48 hr after trainings), salivary samples were collected in especial containers. The control group gave salivary samples only at the beginning and ending of the 8 weeks period and avoided performing any exercise and proceeded their ordinary and regular activities, during the trainings period. It should be noticed, in order to compensate lost liquids, enough drink was considered to drink by participants. The gathered samples preserved in frigid forms and at -20°C until arriving to laboratory and there lab examination started, immediately. It should be mentioned, the participants were wanted to avoid consuming cigarette, alcohol, drug and caffeine at the last nights of samples collecting days and generally during the study stages. All of samples collecting steps are done in the same condition for the whole participants. Also, each participant started and finished her entire training sessions in particular times, which are the same for all of her exercise sessions. Salivary IgA was measured by a microplate Enzyme Linked Immunosorbent Assay (ELISA) and cortisol by ELISA method and using demeditec kit (made in Germany) with sensitivity level of 0.014 (ng/ml) and utilizing ELISA reader device (made in china), for each sample.

Statistical analysis

Descriptive statistics were computed and distributions of all variables were assessed for normality using the Kolmogorov–Smirnov test. Because data have natural distributions, so variance analysis test with repeated measurements was applied, to investigate changes in both continuous and interval groups. Repeated measure ANOVA with between groups factors had been used for comparing training groups. For comparing resting levels of three groups one way ANOVA was used for comparing difference before and after training. If significant difference were found bonforoni post hoc test were used. Data are presented as mean (±SD) unless otherwise stated. Statistical significance was set at $P<0.05$. All measurements were done using SPSS version 16.

Results

Physiological characteristics of the subjects are presented in Table 1.

Table 1. Properties of the subjects.

Variable	Continuous Group	Interval Group	Control Group
Number	7	7	7
Age (years old)	22.28±2.13	22.14±2.47	25.14±2.34
Height (cm)	165.34±4.39	165.86±2.19	166.29±6.65
Weight (Kg)	56.52±13.63	59.6±8.08	67.34±9.59

Resting levels of anthropometric data in three groups showed no significant differences before training ($P>0.05$). Total body mass and percentage of body fat were not significantly changed either in control or training groups after training periods (Table 2).

Table 2. The physiological characteristics (Mean+SD) of the subjects before and after training in three groups.

Group variable	Continuous T group		Interval T group		Control group	
	before	after	before	after	before	after
Weight (kg)	56.52±13.63	55.26±5.73	59.6±8.08	58.3±6.2	67.34±9.59	68.5 ± 3.9
BMI (kg/m²)	20.6 ± 1.4	20.1 ± 1.1	22.6 ± 2.4	22.9 ± 1.5	22.6 ± 2.4	22.9 ± 1.5
WHR	0.88 ± 0.26	0.87 ± 0.31	0.87 ± 0.45	0.87 ± 0.36	0.91 ± 0.45	0.92 ± 0.36
Fat Percent (%)	17.3 ± 4.91	16.8 ± 3.72	19.8 ± 4.1	19.5 ± 3.56	18.4 ± 5.1	18.9 ± 4.56

The chronic effects of interval and continues training on resting s-IgA levels are presented in Fig. 1.

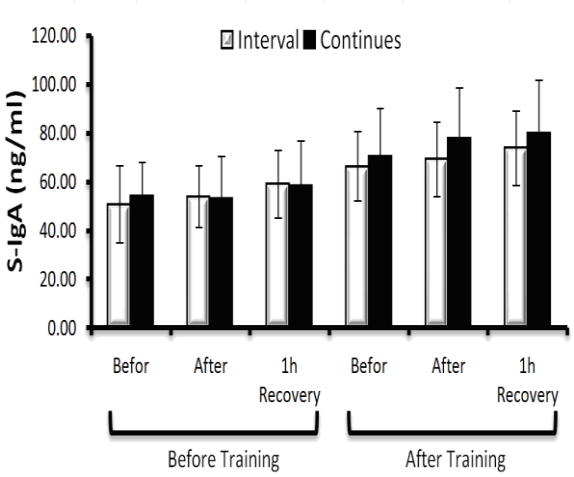

Fig. 1. Mean (±SE) values of s-IgA acute responses before and after training for both interval and continues training groups.

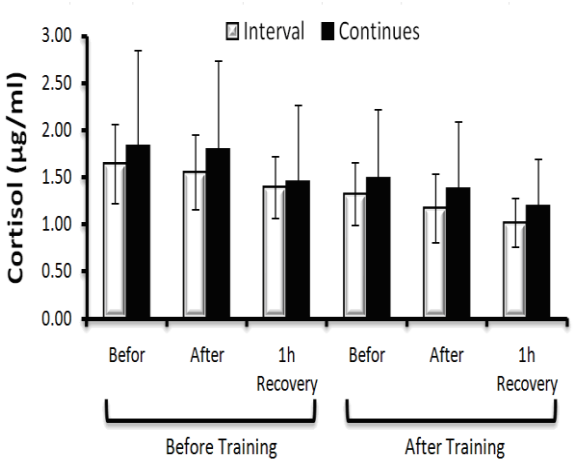

Fig. 2. Mean (±SE) values of s-cortisol acute responses before and after training for both interval and continues training groups.

Repeated-measures ANOVA analysis showed significant effects of training on resting s-IgA in comparison with control group ($F_{2,18}$=4.07, P=0.034), both training group showed significant increase comparing with control group and interval training group have more increase in s-IgA, but in comparing acute response to resistance exercise before and after training data analyze reveled no significant difference between training groups ($F_{2,26}$=1.26, P=0.300).

Statistical analysis of the data indicated that there are no-significant effect of training (Figure 2) on resting levels of cortisol concentrations ($F_{2,18}$=1.23, P=0.317), in comparison with control group.

Also in comparing acute response to resistance exercise before and after training data analyze reveled no significant difference between training groups ($F_{2,26}$=0.06, P=0.942).

Discussion

For the first time to our knowledge present investigation studding acute and chronic responses of s-IgA and cortisol to interval and continuous resistance training in women's. The results of this study demonstrate that progressive eight-weeks of resistance training had no effects on salivary levels of cortisol. But s-IgA had increased significantly especially in interval training group. Acute response to resistance exercise before and after training had no effects on these parameter responses immediately and after 2h recovery periods. S-IgA and cortisol are critical and necessary to control immune response during open windows phase theory after exercise (Crewther, Heke *et al.* 2013). Tartibian and *et al* (2008) reported that after five weeks high intensity wrestling training s-IgA significantly decrease but after ten week training there was no significant change considering resting levels (Tartibian and Abbasi 2008). Nunes and *et al* (2011) studding effects of resistance training timing on performance and

salivary immune responses in elite female basketball players testosterone and cortisol levels were unchanged but IgA was decreased (Nunes, Crewther *et al.* 2011). Hackney *et al* (1995) compared hormones responses between continuous and interval trails of bicycling activity with the same weeks and working loads, and reported a greater significant cortisol response in interval activity than continuous one, which was similar with other results(Hackney, Premo *et al.* 1995). Although, they only used endurance trained subject but McDowell and *et al* (2008), studding Effect of 10 weeks run training on Salivary Immunoglobulin A and Cortisol Responses to Maximal Exercise and results indicates that s-IgA response to maximal exercise was unaffected by moderate (70% of VO_2max) to heavy (86% of VO_2max) training and independent of salivary cortisol (McDowell, Hughes *et al.* 1992). Lack of studies about acute and chronic adaptation of s-IgA and cortisol in women make interpretation of present study difficult(Gleeson 2006; Nieman 2007; Webster Marketon and Glaser 2008). Also, most of these studies have investigated serum levels of cortisol hormone and other hormones that related to immune systems (Patterson, Leggate *et al.* 2013). As has been determined, intensity of activity is the most important variable of exercise, in response to cortisol(Tuan, Hsu *et al.* 2008), and perhaps the reason of resemblance between influences of continuous and interval resistance trainings on salivary cortisol levels is similarity in intensities and duration of trainings. Agha-Alinejad *et al* (2013) reported reduction of cortisol serum in both continuous and interval training groups, in a completely similar research and with the same protocol (Agha-Alinejad, Kohanpour *et al.* 2013). In opposition to founds of Agh-Alinejad *et al* (2013) and in authentication with understandings of the present study, Hakkinen *et al* (2000) reported constancy of cortisol response to a resistance trainings period (Hakkinen, Pakarinen *et al.* 2000). However, with approval at founds of Agha-Alinejad *et al* (2013) and in contrary to understanding of the present research, Kraemer *et al* (1999) showed decrease in cortisol response to resistance activity, following a resistance trainings period(Kraemer, Häkkinen *et al.* 1999). McCall *et al* (1999) observed decrease in cortisol, following resistance trainings(McCall, Byrnes *et al.* 1999). The main reasons for different results of present study maybe is type of training and their intensities because intensity and volume of training program are important factor that affect results (Häkkinen, Kraemer *et al.* 2002; Arazi and Azizi 2011; Nunes, Crewther *et al.* 2011; Gleeson, Bishop *et al.* 2012), therefore only difference in resting period of training program in each session maybe is not enough for making considerable difference in salivary IgA and cortisol and low intensity of training that starts from 20% of 1-RM is another reason for no difference between two groups. As well as measuring salivary levels of IgA and cortisol make the interpretation of results and their comparison with other studies difficult.

Conclusions

Interval and continues strength training it's seem to have no-significant effects upon the salivary IgA and cortisol acute responses but s-IgA resting level was increased after training and this increase was more considerable in interval training groups. The data from the present study suggested that s-IgA and cortisol responses to low intensity progressive interval and continues resistance training had no different in acute responses to strength exercise, and different protocol with high intensity and volumes may be needed for making considerable differences in s-IgA and cortisol levels.

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