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Research Article

THE EFFECTS OF EIGHT WEEKS ENDURANCE, RESISTANCE AND PARALLEL TRAININGS ON ELECTROLYTES SERUMS OF YOUNG WOMEN

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ABSTRACT
In regard of researches shortage about effects of the parallel trainings, the purpose of the present study was comparison of the three types of endurance, resistance and parallel trainings on levels of sodium and potassium serums among young women. Twenty 20-27 year old young females were randomly divided to four groups of endurance, resistance, parallel trainings and control. The three exercise groups participated in 8 weeks endurance, resistance and parallel progressive trainings. Blood samples were taken from the subjects of the four groups, both 48 hrs before the trainings beginning and 48 hrs after the trainings ending. In order to compare changes of under study variables among the four groups, analysis of variance test with repeated measurements was used. There was not observed any significant difference in relaxation levels of neither sodium nor potassium serums, between before and after the three exercise groups ($P>0.05$). Both levels of sodium and potassium serums decreased significantly, among the three exercise groups ($P<0.05$). The only resort to answer the question of decreases in serum levels of the electrolytes is accomplishment of rather accurate and controlled investigations, in the future. Further surveys with more subjects and controlling other effective factors are required.

Keywords: *Sodium, Potassium, Endurance Training, Resistance Training, Parallel Training, Electrolytes*

INTRODUCTION
Physical exercise and sport accompany with physiologic consistencies. Cognition and survey of these consistencies, especially about the equilibrium between water and electrolytes that has an indispensable role in vital reaction of the body, are very important and remarkable. Since, the levels of excretions and absorptions of water and electrolytes exposed various changes through performance of various sport exercises; the perception of these variations is effective about the interpretation of physiologic mechanisms of the body. In this relation, surveying the physiologic influences of the combination of endurance and resistance trainings, which is named parallel trainings, has been concerned by exercise physiologists and researchers, in recent years. Each of endurance and resistance trainings would solely generate different physiologic consistencies and responses, but for the phenomenon of many sport fields, they need combinations of these two types of trainings, which are called parallel trainings (Hakkinen *et al.*, 2003).

Because of separated and different consistencies and responses of endurance and resistance trainings, the physiologic consistencies and responses of parallel trainings has become blurry, therefore many exercise physiology scientists have exclusive focus and interest about the parallel trainings, in the recent years. In spite of voluminous researches, the still ambiguous and contrary results and even not surveyed issues have provided a vast research domain. In the other hand, the measurements of urine and blood electrolytes, following various exercise protocols could aid the superior understanding of acute and chronic effects of the parallel trainings. The electrolytes like sodium and potassium are the ones that their levels are influenced by physical exercises with different intensities, spans and types (Mooren *et al.*, 2001).

Since, the athletes are severally exposed induced-exercise muscle cramps, the researches conceive electrolytes and liquids disorders are the reason of arising this phenomenon (Stofan *et al.*, 2005). Therefore, heavy exercise preserves the liquids and most of electrolytes, except serum potassium (Zorbas

et al., 2001). Besides the exercise intensity, the type of training could play a handful role in electrolytes excretions. During exercise, changes in tonicity of the body could origin from disequilibrium between absorptions and excretions of sodium and potassium serums and water, which are dependent to renal or adrenal mechanisms (Mallie *et al.,* 2002).

The long-term excretions are hazardous to the equilibrium of electrolytes, and might lead to mild hypothermia (Noakes *et al.,* 2005). Several researches observed significant increments of sodium plasma among the subjects who performed physical exercises (Rocker *et al.,* 1989). However, some researchers did not find any significant variation in sodium plasma (Jokinen *et al.,* 1991). By surveying the influences of long-term trainings on concentrations of inner cellular erythrocytes and potassium plasma, the researchers concluded that the exercise span has direct and reverse relations to level of urinary potassium excretion and variation of potassium plasma concentration, respectively (Lijnen *et al.,* 1989). Some increases in the levels of potassium plasma have been seen among athletic and untrained persons, and these increments are proportional to exercise intensities (Lindinger and Sjogaard, 1991). However, the effects of parallel trainings on excretions of electrolytes of the serums have not been investigated appropriately, and are still ambiguous.

The aim of the present study was determination and comparison of the effects of 8 weeks endurance, resistance and parallel trainings on levels of sodium and potassium serums of young women

MATERIALS AND METHODS

Subjects

The statistical society of this research consisted of the entire girl students, who studied in the universities of Tehran city. Twenty-eight 20 to 27 year old active female students declared their readiness to participate in the research, during announcements in the universities of Tehran cities. They were chosen purposefully and in access as the subjects, and randomly divided to four groups of endurance, resistance, parallel and control training groups (7 persons in each group). According to examinations and approvals of physician, the whole subjects had perfect physical healthiness. The demographic properties of the subject have been presented in table 1.

Table 1: The subject's demographic properties

Variable	Endurance	Resistance	Parallel	Control	Overall
Age	25.857±4.140	23.428±3.154	24.428±1.618	23.428±3.505	24.285±3.218
Height	168.71±1.976	166.14±5.928	169.29±4.608	165.29±3.638	167.36±4.390
Weight	62.285±2.870	63.142±6.256	64.571±5.996	59.714±4.889	62.428±5.202
BMI	21.914±0.782	22.844±0.933	22.502±1.178	21.858±1.293	22.280±1.08

Data Collecting Method

The subject became familiar with trainings protocol in a justification meeting, one week before the research execution. In meeting, 48 hrs before the trainings beginnings and blood samples were taken from the subjects of the entire four groups. Then, the subjects carried out their trainings schedules, in a progressive figure and in duration of 8 weeks. The control group did not obey any regular trainings schedule and only performed their daily usual activities. The last samples collecting session held after ending of 8 weeks trainings and following a rest proportional to the interval between the first samples collecting day and the trainings beginning (48 hrs), and the subjects of the whole four groups gave their blood samples.

Trainings Schedule

The endurance, resistance and parallel trainings schedules were executed, in duration of 8 weeks (three weekly sessions). The exercise assigned to the endurance group consisted of running with intensity of 65 percent of maximal heartbeat on treadmill in span of 20 min for the first week, which reached to 85 percent of maximal heartbeat for the eighth one. The exercise assigned to the resistance group involved

execution of four movements (legs press, bench press, calf and underarm stretches). The first week was executed with 50 percent of a maximal repetition (in two turn with 10 repetitions and 1-2 min rest sequence between each 2 turns). The exercise intensity increased progressively, and reached to 80 percent of a maximal repetition at the eighth week (in 3 turns with six repetitions). After ending of the first 4 weeks, 1RM was measured again, and the resistance trainings schedules were designated according to the new 1RM. The exercise assigned to the parallel group contained the combination of the two endurance and resistance groups, with the same figures that were being executed at each turn. In order to prevent from untimely exhaustion of endurance exercises, the resistance exercises performed before the endurance ones, always. The subjects of the three exercise groups warmed up and cold down in spans of 10 min before beginning and after ending of each exercise, respectively.

Samples Collecting and Serum Samples Analysis

The blood samples were gathered from the subjects, both 48 hrs before the trainings beginnings and after the trainings ending. The blood samples were taken from the middle vein (basilic) of each sample in amounts of five cc. The gathered blood samples were poured in sterilized pipes of K3EDTR. The EDTR and heparin pipes were deposited in ice, and then remained in the room temperature, for few minutes. Thereafter, serum separated from plasma by centrifuge in span of 10 min and with revolution of 3500 rpm. The whole blood samples were preserved at temperature of -20℃ and used at the time of lab examination. It should be mentioned, the participants were asked to avoid smoking and consumption of alcohol and caffeine, at the nights before samples collecting days and generally during the stages of the research. The whole steps of samples collecting performed for each participant, in the same conditions. Sodium and potassium serums were gauged by the method of *Flain Photometry* (*mEq/L*) upon unit, for each sample.

Statistical Approach

At first, value of each under study variable was described by using mean and standard deviation, and Smirnov-Kolmogorov test was implemented to survey naturalness of data distribution and choosing the usage of either parametric or non-parametric tests. Since the data had natural distribution, factor analysis of variance test with repeated measurements was applied, to investigate and comparison of variations of under study variables among the four groups of endurance, resistance, parallel and control. Data sphericity was also surveyed to implement Greenhouse-Geisser modification on the relevant degree of freedom, in necessary cases, simultaneously with using variance analysis test. The significance level was assigned as 0.05 for entire statistical tests. In addition, the statistical software SPSS v.16 was utilized for statistical calculations.

RESULTS AND DISCUSSION

Table 2: Statistical descriptions of sodium and potassium serums

Variables	Group	Before Training	After Training
Sodium (*mEq/L)*	Endurance	143.57±2.760	141±2.581
	Resistance	144.57±2.760	141.29±3.946
	Concurrent	144.14±2.794	141.57±3.408
	Control	141±3.915	141.29±3.352
Potassium (*mEq/L)*	Endurance	4.557±0.454	4.128±0.205
	Resistance	4.542±0.330	4.257±0.369
	Concurrent	4.657±0.127	4.271±0.419
	Control	4.457±0.355	4.442±0.287

Statistical descriptions about values of sodium and potassium of the blood have been presented in table 2. The values were reported as mean and standard deviation. Statistical results of factor analysis of variance test with repeated measurements to compare variations of sodium and potassium serums among the four groups have been represented in tables 3 and 4, respectively.

Table 3: Statistical results of factor analysis of variance test to compare variations of sodium serum among the four groups

Factor	Sum of Square	df	Mean Square	F	P	Effect Size	Observed Power
Time	58.018	1	58.018	8.281	0.008 *	0.257	0.788
Group	28.625	3	9.542	0.688	0.568	0.079	0.173
Time*Group	26.339	3	8.780	1.253	0.313	0.135	0.292

** The mean difference is significant at the 0.05 level*

Table 4: Statistical results of factor analysis of variance test to compare variations of sodium potassium among the four groups

Factor	Sum of Square	df	Mean Square	F	P	Effect Size	Observed Power
Time	1.086	1	1.086	11.143	0.003 *	0.317	0.893
Group	0.127	3	0.042	0.336	0.800	0.40	0.106
Time*Group	0.364	3	0.121	1.243	0.316	0.134	0.290

** The mean difference is significant at the 0.05 level*

Time operation was significant (P=0.008), though group operation and time-group cooperation were insignificant (P=0.568 and P=0.313, respectively), about sodium serum. Overall, sodium serums of the three exercise groups decreased significantly (P=0.008), but there was not any difference between the three exercise groups (P=0.313). Time operation was significant (P=0.003), though group operation and time-group cooperation were insignificant (P=0.800 and P=0.316, respectively), about potassium serum. Generally, potassium serums of the subjects of the three exercise groups decreased significantly (P=0.003), but there was not any difference between the three exercise groups (P=0.316).

According to the results of the present study, there was not observed any significant different in effects of 8 weeks endurance, resistance and parallel trainings on sodium levels, among young women. Indeed, the whole three exercise groups would cause significant reductions of sodium serum, among young females, but the differences between the three groups were insignificant. Overall, the present understandings showed the research groups did not follow any variations pattern, which is statistically different, over time. Several researches observed significant increments of sodium plasma among subjects, who performed physical exercises (Rocker *et al.,* 1989).

However, some researchers did not find any significant change in sodium plasma (Jokinen *et al.,* 1991). Significant increases in sodium plasma have been observed among subjects, who carried out physical exercises (Rocker *et al.,* 1989; Kubica *et al.,* 1983). By investigation of the relations between decreases in plasma volumes and changes in plasma electrolytes following long bicycling among eleven subjects, Kubica *et al.,* (1983) concluded that the concentrations of sodium plasma had increments, always (Kubica *et al.,* 1983). Ahmadi *et al.,* (2009) reported one aerobic exercise session would lead to significant increments of sodium serum concentrations. Zambraski *et al.,* (1990) declared the sport exercise would naturally cause reductions of sodium excretions. Poortmans (1984) stated the decrease in sodium excretion through the sport exercise might mainly because of the during exercise aldosterone production. Rocker *et al.,* (1989), Kubica *et al.,* (1983) and Jemsi *et al.,* (1995), observed increments of exercise-induced sodium serum. In contrast, Rovira *et al.,* (2007), and Astrand and Saltin (1964) noted incongruous results to those of the three previous researches. Astrand and Saltim (1964) observed nonbeing variation of sodium plasma, following an 85 km cross-country sky competition.

Based on the understandings of the present study, there was not noticed any significant difference between the effects 8 weeks endurance, resistance and parallel trainings, among young women. Actually, all of the three exercise groups would cause significant decreases in potassium serum, among young females, though the differences between the three groups were insignificant. Generally, the present founds showed the research groups did not obey any variation pattern, which is statistically different, over time.

By surveying the effects of long-term exercises on concentrations of potassium plasma, some researchers concluded the span of exercise has direct and reverse relations versus the level of urinary potassium excretion and variations of potassium plasma concentration, respectively (Lijnen *et al.,* 1989).
Increases in the amounts of potassium plasma have been observed, following heavy exercises, among both athletic and untrained people (Lindinger and Sjogaard, 1991). In addition, potassium plasma would increase proportional to intensity of the exercise (Freund *et al.*, 1991). By investigation of the relations between reductions of plasma volumes and variations of plasma electrolytes following long bicycling among eleven subjects, Kubica *et al.,* (1983) drew a conclusion that concentrations of potassium plasma would decrease after long physical exercises. In study of Ahmadi *et al.,* (2009), an aerobic activity session would cause significant increment of potassium plasma, which its reasons might partly correlate to decreases in liquids of the plasma and somehow relate to releasing and returning of potassium from the inner-cellular medium, and this process occurs in the muscles, liver and red globules (Shireffs *et al.*, 2005). Rocker *et al.,* (1989), Kubica *et al.,* (1983), Astrand and Saltim (1964) and Mashiko *et al.,* (2004), noted significant increases in potassium serum, following physical exercises, whereas Jemsi (1995) and Rovira *et al.,* (2007) reported incongruous results. Perhaps, the incongruity between results of various researches relates to the differences in sample collecting moments, trainings protocols, under study societies and exercise situations of their subjects. In addition, most previous researches have examined the effects of an exercise session rather than a trainings period. Moreover, there are rare studies that have investigated and compared the three techniques of endurance, resistance and parallel exercises. Therefore, an accurate conclusion could not be drawn, before accomplishment of further studies. However, in the present study, all of the three endurance, resistance and parallel trainings, which were executed in duration of 8 weeks (three weekly sessions), would cause decreases in serum levels of sodium and potassium, and there was not observed any difference between the three types of exercises, about this matter. Nevertheless, further studies should still accomplish to present a sure conclusion, which involves various research conditions. There is not adequate and in access information, about serum levels of sodium and potassium, in consistencies and responses to the parallel exercises.

Conclusion

According to the results of the present study, it is concluded that there are no significant differences in relaxation levels of both before and after the 8 weeks trainings, between the three techniques of endurance, resistance and parallel exercises. In addition, levels of both sodium and potassium serums decreased significantly, among all of the three exercise groups. It seems there are no differences between the three exercise groups, about this issue. Nevertheless, further researches are still required. However, the decreases in serum levels of the electrolytes, which took happen in this study, is a question that needs the accomplishment of rather accurate investigations and more controlled researches, in the future. Perhaps, the electrolytes excretions have increased through perspiring. If the future researches will survey the recent issue with details, some ambiguities may erase.

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