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The Influence of High Intensity Aerobic Exercise on The Proteinuria in 11-13 Year Old Sedentary and Active Students

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ABSTRACT

Background: Proteinuria is one of the complications of exercise on the urinary system. The purpose of this investigation was to evaluate the effect of high intensity aerobic exercise on the proteinuria in 11-13 year old sedentary and active students.

Methods: This semi-experimental study was carried out with random sampling method on 28 healthy students of 11-13 years old elementary school of Shahid Jeddi in the city of Ardabil. Based on the records of the shuttle run test, the subjects were divided into two active and sedentary groups and then each group divided into experimental and control groups. Experimental groups ran 1600m with their all effort. The albumin, total protein and creatinine of urine were measured before, immediately, and 1 hour after intervention.

Results: There were no significant within and between group differences in the level of albumin and total protein in any group ($P > 0.05$). Only in active students, creatinine of experimental group showed a significant decrease 1 hour after exercise compared with before exercise and the control group ($P < 0.001$).

Conclusions: According to the results of this study, doing one session of high intensity aerobic exercise in sedentary and active students does not result in proteinuria.

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Keywords: *Exercise-induced Proteinuria; Aerobic Exercise; Sedentary Students; Active Students*

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INTRODUCTION

Despite the positive effect of exercise on body function (1), many have shown that exercise has some complications in some cases (2). Exercise-induced proteinuria is one of these complications that results from defect in the functioning of the kidneys. The most important function of the kidneys is to filter the plasma and remove the some of the wastes, depending on the requirements of the body (3). The maximum level of protein excretion in healthy people is 150 $mg.day^{-1}$ or 10 $mg.dl^{-1}$ and protein excretion more than this referred to as "proteinuria" (4). Proteinuria is one of the most important symptoms of renal disease, which indicates that kidneys have not been able to prevent the passage of this substance (5). Proteinuria has no specific symptoms and can only be detected by urine tests (2). Among the mechanisms involved in exercise-induced proteinuria, high intensity and collision exercises, is possible to reduce renal blood flow, increase glomerular filtration rate, increase lactate and decrease tubular reuptake (6). As a result of intensive exercise, reduced blood flow in the kidneys leads to increased glomerular permeability, resulting in excretion of protein molecules into the urinary tract (7).

In general, most studies have shown that long duration and high-intensity exercises have a destructive effect on the urinary system, especially those that associate with severe impacts and shocks (8). For example, Khodaei et al. investigated the effects of interval exercise on albuminuria in students aged 12-14 years. Urinalysis was performed immediately and 45 minutes after exercise and the results indicated a significant increase in albuminuria immediately after exercise (9). Furthermore, Senturk et al. in another study, showed that proteinuria was occurred in subjects after 4 minute running, 3 sets with intensity of 80%, 85% and 90% of the maximum heart rate on the treadmill (10). In general, the effects of different patterns of physical activity with different intensities and a constant duration on the type and amount of proteinuria are not specified.

In schools, in physical education classes, sports activities are carried out in different forms and intensities (2). It is common for these hours that students do intensive exercise while outside the school, they have no regular activity (11). The important point is that proteinuria occurs more often for non-athlete subjects than athletes (2), and most students are non-athletes and adolescents. According to the research background, there is little information on the intensity of sub maximal exercises on urinary protein excretion, in different patterns with control of severity and duration of exercise (11). Moreover, most researches have only addressed either active or sedentary group of subjects, and many studies have not sought to investigate and compare the active with sedentary groups. Therefore, the present study was to compare the effect of high intensity aerobic exercise on proteinuria in active and sedentary students.

MATERIALS & METHODS

The statistical population of the study included all male students aged 11-13 years old in the city of Ardabil, northwest of Iran. After obtaining the necessary permissions from the General Directorate of Education in Ardabil province, 60 healthy 11-13 year old students of Shahid Jedi elementary school were selected based on inclusion criteria. Afterward, full explanations (written and oral) of the research and its steps, how they were conducted, the purpose of the research and the conditions for participation in the test were presented to the subjects. At first, a health and physical activity level questionnaire were used to ensure the health of students. Then, to ensure that the subjects are active or sedentary, a shuttle run test was conducted, which was a student-specific VO_2max estimation test. Finally, 28 qualified students as subjects of this study were selected by simple randomized sampling method. According to the results of the test, students were divided into two active (with regular exercise and high VO_2max) and sedentary (without any regular exercise and low VO_2max). Subjects were asked not to participate in any physical activity for up to 24 hours prior to the onset of the trial. The trial was 1600 meter running with all effort for experimental groups. Sampling time for urinalysis was also determined before, immediately after, and one hour after the exercise.

The total protein, creatinine, and albumin in the urine were measured using the COBAS INTEGRA 400/800 (Roche Company, Germany). A turbidometric test was used to determine the amount of total protein and albumin in urine. In this method, the proteins are initially denatured in an alkaline buffer, and then, in the vicinity of benzonitinium

chloride, the turbide produced at a wavelength of 512 nm is read. To determine the amount of creatinine in the urine, the Gaussian test method was used. The basis of this method was a kinetic calorimetric experiment, in which a sample in an acidic environment adjacent to acidic pyretica creates a yellow-red complex, and the difference in light absorption in two specified times, determine the level of creatinine.

Statistical Analysis

Descriptive statistics was used to assess demographic characteristics of subjects (age, height, weight and BMI). Data was then analyzed by repeated measure method, in order to determine the within and between group changes during the study period. If the between group differences were significant, independent t-test was used to evaluate between group changes at each time. Statistical analysis was performed at the significance level of $P < 0.05$, using SPSS software version 23.

RESULTS

Demographic characteristics of the subjects of each group are presented in table 1. The changes of albumin, total protein and creatinine have demonstrated in table 2. According to Table 2, within group changes showed only significant differences in the creatinine level of the active subjects in the experimental group ($P < 0.001$). The results of Bonferroni post hoc test showed that there was a significant difference between the pre test and one hour after test of creatinine in active experimental group ($P < 0.001$). The results of independent t-test showed that one hour after test, was significantly different between experimental and control groups just in creatinine ($P = 0.004$).

Table 1. Demographic characteristics of subjects (mean ± SD)

Groups		Age (yrs)	Height (cm)	Weight (kg)	BMI (kg. m^{-2})	VO_2max (ml. kg^{-1}. min^{-1})
Active	Experimental (n=7)	12.71 ± 0.95	151.00 ± 3.69	50.85 ± 3.67	22.30 ± 1.29	51.24 ± 2.11
	Control (n=7)	13 ± 0.11	148.71 ± 1.79	48.28 ± 3.72	21.83 ± 0.91	50.30 ± 1.93
Sedentary	Experimental (n=7)	13 ± 0.10	154.28 ± 5.37	55.14 ± 5.89	23.25 ± 1.24	29.47 ± 2.10
	Control (n=7)	12.85 ± 0.37	152.14 ± 0.37	56.57 ± 3.86	24.48 ± 1.77	28.82 ± 2.00

Table 2. Albumin, total protein, and creatinine levels in experimental and control groups at each time (mean ± SD). * shows significant decrease compared with control group and 1hour before exercise in active experimental group.

Groups	Variables	Type of Groups	Before Test	Immediately After Test	1 Hour After Test
Active	Albumin (mg. dl^{-1})	Experimental	6.34 ± 2.66	8.57 ± 9.84	9.42 ± 2.37
		Control	10.71 ± 4.38	10.28 ± 6.31	12.48 ± 8.33
	Total Protein (mg. dl^{-1})	Experimental	7.28 ± 3.40	10.85 ± 11.76	4.00 ± 4.50
		Control	7.00 ± 5.47	8.42 ± 5.02	7.14 ± 5.27
	Creatinine (mg. dl^{-1})	Experimental	110.00 ±18.92	65.71 ± 39.62	34.85 ± 33.18*
		Control	110.00 ± 43.77	102.85 ± 43.47	112.85 ± 48.03
Sedentary	Albumin (mg. dl^{-1})	Experimental	9.28 ± 1.60	8.28 ± 3.09	9.42 ± 3.89
		Control	9.54 ± 4.41	7.34 ± 4.31	8.42 ± 3.59
	Total Protein (mg. dl^{-1})	Experimental	10.00 ± 4.24	7.71 ± 5.43	18.28 ± 6.79
		Control	10.14 ± 6.66	8.92 ± 7.08	8.85 ± 4.18
	Creatinine (mg. dl^{-1})	Experimental	105.00 ± 49.24	83.14 ± 57.01	150.71 ± 58.76
		Control	105.00 ± 9.15	94.28 ± 30.60	88.57 ± 47.14

DISCUSSION

The findings of this study showed that in sedentary students, performing a session of intensive aerobic exercise in the experimental group compared with the control group did not have a significant effect on the excretion of urine albumin, protein and creatinine (Table 2). In active students, in the experimental group compared with the control group showed a significant decrease on the amount of creatinine excreted (Table 2). Similar to the results of this study, Babaei et al. showed motor patterns and sub-maximal intensity of physical activity did not affect the proteinuria of active young males (11). Rafati et al. also evaluated the effect of 8 weeks of running on treadmill on albumin protein excretion in chronic kidney patients, which the results were consistent with our findings in current study (5). Probably similarity in the intensity of exercise and the time of sampling can be the reasons for these studies being consistent with the results of our research.

Contrary to our results, proteinuria after exercise has been reported in many studies. For example, after eight weeks of resistance training in 7 young females aged 20 to 25 years, urinalysis was performed immediately and one hour after exercise, and a significant increase in hematuria and proteinuria was observed (12). Russo et al. also examined the effect of sprint training on the proteinuria of male football players and reported proteinuria in those subjects (8). Furthermore, the results of the research by Senturk et al. showed proteinuria in the subjects (10). The reason for the inconsistency of the results of this research with the present study may be noted due to the type of subjects and exercise protocols.

The results of this study also showed that the levels of creatinine decreased significantly after exercise. Our results were consistent with the results of some studies (5, 13, 14), but they were inconsistent with the results of some other studies (15-18). One of the possible reasons for this difference was sampling time. In the present study urine samples were taken immediately and one hour after the exercise session. Urine samples were also collected instantaneously, whereas in order to obtain more accurate and clear results, especially in the case of creatinine, urine samples should be collected as 24-hour samples (19).

The time of exercise and weather conditions is also important for practicing subjects because exercise and physical activity in hot weather cause sweating and increase the excretion of some wastes such as urea and uric acid in the sweat and thus the concentration of these substances in blood serum and subsequent urine decrease. In a study that examined the levels of uric acid and creatinine in very hot weather, it was concluded that sweating during exercise in very hot weather reduced uric acid and creatinine (20, 21). Our research was also carried out in the indoor and warm environment, which can lead to increased sweating and, consequently, a reduction in the level of creatinine in the blood.

Furthermore, the type of biochemical factor measurement method is influential factor. Similar to some studies, selected factors were randomly assigned to collect urine (5, 15). In seems biochemical factors were measured by urine has a lower correlation with renal function than blood measurement methods.

Finally, the type of exercise protocol can be another factor for inconsistency. In the present study, the low duration exercise may be one of the reasons for the lack of effect on exercise levels on the selected markers (16, 17). It seems that the duration of the exercise in the present study was not sufficient.

CONCLUSIONS

Overall, the results of this study showed that high intensity exercise in sedentary and active students did not cause proteinuria. At present study, there is no evidence of the harm of exercise-induced proteinuria and so it seems there is no need to restrict students from physical activity. Therefore, it is suggested for educators, teachers and sports coaches to encourage students to take part in high intensity sports activities rather than worrying.

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