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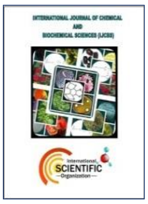

The effect of detraining after a period of aerobic activity on maximum oxygen consumption and blood plasma lipoproteins

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Abstract

This study aimed to investigate the effect of an eight-week aerobic activity program and a 4-week training period on the maximum oxygen consumption and blood plasma lipoproteins of female players in the Khuzestan Basketball Premier League. For this purpose, 24 female players of the Premier Basketball League between the ages of 18-and 28 participated in the study voluntarily. Maximum oxygen consumption and blood sampling before the training period tests after eight weeks of aerobic training and at the end of four weeks of detraining. The exercise program consisted of eight weeks of aerobic exercise three sessions per week and each session lasted 60 minutes with an intensity of 70 to 75% of the maximum oxygen consumption. A dependent t-test and retest follow-up test was used to analyze the data at a significance level of $p \leq 0.05$. The research results showed that; Eight weeks of aerobic activity had a significant increase in maximal oxygen intake and high-density lipoprotein (HDL) and a significant decrease in low-density lipoprotein (LDL) and very-low-density lipoprotein (VLDL). Also, after 4 weeks of training, adverse effects were observed on the maximum oxygen consumption of blood lipoproteins in female basketball players.

Keywords: Aerobic exercise, Detraining, Maximum oxygen consumption, Blood plasma lipoproteins.

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1. Introduction

Aerobic power is one of the important capabilities for the successful performance of athletes which develops during the training stages and maintaining it is one of the most important tasks of coaches and athletes in different training seasons. The main factor that harms the strengthening and development of bio motor capabilities is the issue of detraining or the athlete's distance from the order and coherence of daily and appropriate exercise. If the reason for stopping training is an illness, injury, or being in the resting and post-competition season, the athlete loses the effects and benefits of training for a short time, which may vary from several months. Research has shown that; a significant reduction of 6 to 7% in maximum oxygen consumption, physical work capacity, blood volume, and hemoglobin level of athletes occurs only after a week of complete rest, and the major athletes recover after 4 to 8 days. Miss a week of detraining. Exercise will reduce all of these problems, and exercise will have a significant effect on maximal oxygen consumption (VO2max) and plasma lipoproteins, and these adaptations vary from sport to sport [1]. There is also an increase in HDL-C (repeated meager) and a decrease in LDL-C (low-density lipoprotein cholesterol), VLDL-C(high-density lipoprotein cholesterol) after a period of intense aerobic activity. Higher levels of aerobic fitness are associated with a favorable lipoprotein profile. Blood pressure and heart rate decrease due to physical activity, on the other hand, physical activity, especially endurance, causes positive changes in the respiratory system. Maximum oxygen consumption decreases by 4 to 14% in less than 4 weeks in people who exercise with aerobic power and high training history. This shows that; Maximum oxygen consumption is maintained at a high level at the beginning of the cessation period. Although some studies have reported that; Maximum oxygen consumption in athletes is maintained during the cessation period. This discrepancy may be related to the amount of physical activity performed by the athletes during the previous stages. In trained athletes in various sports, the maximum oxygen consumption in the detraining period is reduced by 6 to 20% in about 8 weeks and gradually and partially returns to the pre-workout state but then it is fixed at a higher level or equal to the inactive people who were in the control group. Maximum oxygen consumption of people who have just started exercising and have a 4 to 8-week training background is reduced to a smaller amount (3.6 to 6%) when they stop exercising. This amount will be less in the ratio of training time to high detraining and even the maximum oxygen consumption may remain unchanged. Many studies on these individuals show a complete return of maximal oxygen consumption to pre-workout levels after a workout of at least 6 weeks but different amounts of maximal oxygen consumption obtained from exercise are maintained [2]. Despite the decline in cardiovascular disease over the past few decades, it is still the leading cause of death for men and women in today's industrialized world and is predicted to be the predominant disease in 2020. Studies show that; Regular exercise in a variety of ways, including increasing HDL-C, may have anti-inflammatory effects and thus protective effects against cardiovascular disease. Findings from several retrospective studies of veteran athletes who have become inactive after leaving the sport and other subjects showed that the values of inflammatory and blood lipid indices increased significantly due to detraining, while the levels of antioxidant defenders decreased during the detraining period. Based on different findings, HDL-C levels decreased significantly during the detraining period. These findings further highlight the importance of being prepared to avoid losing training gains. Cross-sectional research data showed; that for every mg / dL increase in HDL-C, a 2% and 3% reduction in cardiovascular risk occurs in both men and females, respectively [3].

Wang et al. (2004) investigated the effect of exercise and detraining on low-density lipoproteins and their function. The study included 10 inactive men who had not exercised regularly for a year before the study. Samples were operated with ergometers for 8 weeks, 5 times a week, and a 30-minute session with 50% of maximum oxygen consumption. After a 12-week detraining period, blood samples were taken every 4 weeks. The results showed that; Total cholesterol and low-density lipoprotein levels after a period of detraining (151 7 7 mg / dL) (58 2 2 mg / dL) to (133 6 6 mg / dL, 46 ، 2 mg) per deciliter). But in the detraining period, all the effects of the training period were returned to their original state [4].

Christopher (2000) also conducted a study entitled: Sedentary lifestyle, exercise and detraining, blood lipoproteins (study of intensity and amount in a controlled manner). 240 non-athlete samples were overweight and were randomly divided into three experimental groups: 1) high activity / high intensity 2) low activity / high intensity 3) low activity / moderate intensity for 6 months. The activity included practicing with a treadmill. The results showed that; after a period of detraining, there was a significant increase in the number of low-density lipoprotein (LDL) concentrations of low-density lipoprotein, LDL-C. Also, 15 days of detraining harms lipoprotein metabolism but in moderation, not too severely, it prevents HDL decrease, triglyceride increase, LDL V and LDL. Most athletes are afraid of losing all the skills they gained through hard training while not training [5]. What happens when the season of competition and daily training of athletes who are at their peak in terms of performance ends abruptly? Many athletes who train 2 to 5 hours a day welcome such an opportunity to relax but how does detraining affect trained athletes? Therefore, in this study, we saw to find physiological responses such as maximal oxygen consumption and blood lipoproteins after a period of training athletes.

2. Materials and Methods

The research method is quasi-experimental and applied. The statistical population in this study; included all female players aged 18-28 in the Khuzestan Basketball Premier League in 2009, The samples of the present study were 60 players voluntarily after completing the questionnaire, However, 31 people were selected and due to homogenization, 24 people were selected as the sample. The measuring instruments in this study included: a questionnaire for the mental and physical health of the auto analyzer device for blood sampling and a one and a half-mile running test for running to measure the maximum oxygen consumption. The method of data collection was as follows: After filling in the questionnaire and determining the lack of medical history, the height and weight of the subjects were measured. Subjects were asked to cover a distance of one and a half miles, and the distance traveled (meters) and weight (kg) were included in the following formula to calculate the maximum amount of oxygen consumed.

[Maximum oxygen consumption= 88.02- 0.16 (Weight in kg) – 2.76 (Time in minutes) +3.716 + gender]

In this formula, a score of one is written for men and zero for women. After that, the eight-week program was performed in two four-week cycles and three 60-minute sessions each week with 55 to 70% heart rate for three weeks with overload and one week without overload. The program of a training session includes a warm-up, the main exercises in which the first week of intermittent aerobic exercise with 55% intensity and maximum heart rate and gradually 5%, the intensity of exercise was increased every week. The exercises included endurance running and circular exercises, followed by 5 minutes of cooling, stretching, and two slow movements. Also, descriptive statistical methods such as standard deviation, mean and dependent inferential t-test, and retest follow-up test were used at a significance level of $p < 0.05$ to investigate the differences between different stages.

3. Results and Discussions

According to the results the maximum amount of oxygen consumed depends on the function of the three respiratory, cardiovascular and muscular systems. Aerobic exercise affects all three of these devices. As a result of endurance exercises, adaptations are created in these three devices, which increase the maximum aerobic capacity and tolerance of people against heavier exercises. As clearly observed in this study, therefore, increasing aerobic power after eight weeks of aerobic exercise in this study can be justified. Increased plasma volume is one of the most important changes caused by endurance training whenever the plasma volume increases. Blood volume, stroke volume, and cardiac output increase, which increases maximal oxygen consumption [6]. The results of the research are almost consistent with the results of Helgerud et al. et al. (2007) and Shiasi (2007) [7, 8]. On the other hand, since aerobic activity causes a series of biochemical changes, including increased fat oxidation and increased activity of the enzyme lipoprotein lipase in the body, also due to some hormonal changes that occur during physical activity and eventually all these changes lead to accelerated lipolysis in the body. The results of this study are consistent with the results of Cesczyk's research, which examined the effect of exercise on adult male lipoproteins, and are inconsistent with the results of Mitsuji et al. (2005) who performed the effect of aerobic exercise with low and high intensity on lipoproteins in the elderly. Factors other than physical activity, such as age, appear to have been influential. Detraining is an inevitable phenomenon that always occurs in the sports life of athletes and then it will have its negative effects on the performance of athletes and indicators related to their performance and performance in proportion to the length of the training period. Schumark et al. (1998) state in their findings that; during detraining the characteristics of respiratory function in trained individuals experience a rapid decline which occurs as a decrease in the maximum volume of respiration along with a decrease in the maximum oxygen consumption and a decrease in oxygen intake per heartbeat and an increase in respiratory exchange. In athletes trained in various sports, the maximum oxygen consumption during the detraining period is reduced by 6 to 20% in about 8 weeks and gradually returns to the pre-workout state but then it is fixed at a higher level or equal to the inactive people in the control group [9].

The results of the study were consistent with the results of Hashemi (2007) who examined some physiological parameters such as maximum oxygen consumption after detraining and shiasi (2007) who examined the effect of four weeks of detraining after eight weeks of aerobic exercise on maximum oxygen consumption. . According to Madsen et al. (1993), four weeks of detraining had no effect on maximal oxygen consumption and is inconsistent with the findings of the present study but it reduced endurance capacity by about 21 percent, reducing the average performance from 79 to 62 minutes. It seems that changes in material consumption and regulation of electrolytes can be the cause of reduced endurance capacity [10]. However, in some reported studies, such as Souri et al. (2007), the maximum oxygen consumption in athletes was maintained during the cessation period. This discrepancy may be related to the amount of physical activity performed by the athletes during the previous stages. The effect of detraining on different indicators is different. For example, the local endurance factors gained as a result of a training period are lost much faster than the strength factor during the first weeks of detraining [11]. In sedentary people who did endurance training for six weeks, ATP production decreased by about 12 to 28 percent during the three weeks of post-workout detraining, although 37 to 70 percent of ATP was higher than pre-workout levels. Therefore, it can be accepted that the reason for this decrease is in the activity of mitochondrial enzymes [12].

Maintaining the consistency of endurance training is possible only by continuing to train regularly. Adjustments resulting from exercise in periods of detraining disappear. Some variables can change a lot in a short time. A period of detraining is very dangerous for those who have been professional athletes, because if the detraining period increases and the HDL / LDL ratio increases <5, it is considered an alarm for the athlete, and hypertriglyceridemia occurs, which increases the risk of coronary heart disease by up to 6 times. While some studies suggest that; the benefits of training after a period of detraining are the same between athletes and inactive people. Lipoproteins are so sensitive to the period of detraining that Petty Boys et al. (2004) concluded in their research that; after less than five weeks of detraining, the amount of lipoproteins has changed and the benefits of aerobic activity on lipoproteins have diminished. During the detraining period, there is a rapid increase in body fat; among the reasons is the increase in the secretion of leptin, a hormone that stimulates lipase and insulin, which leads to an increase in the acceleration of body fat levels. An increase in leptin levels decreases the activity of the hormones lipase and PL-LPL and helps to reduce and increase fat storage. In this study, the difference between the means of low-density lipoprotein (LDL), very-low-density lipoprotein (VLDL), and high-density lipoprotein (HDL) after exercise and after four and eight weeks of detraining is significant [13].

The main benefits of physical activity are an increase in HDL-C levels and a decrease in LDL-C levels and high insulin sensitivity to glucose. In addition, it increases the plasma transparency of postprandial blood lipoproteins such as chylomicrons. During the circulation of chylomicrons, the activity of the catalytic enzyme lipase rapidly lowers the level of blood lipoprotein. Aerobic activity affects PL-LPL activity. PL-LPL is higher in people who do regular aerobic exercise but is decreased by detraining. The results of this study are consistent with the research of Chris et al. (2007), Lane et al. (1995) and are inconsistent with the findings of Petty Boys (2004) and Christofferson et al. (1991) Probably the reason for inconsistency with this research can be considered longer courses, type of exercise, age and gender of participants [14, 15, 16].

However, other factors may also be involved in altering lipoprotein levels during aerobic exercise as well as during detraining, which requires further research. Therefore, athletes are advised to maintain adaptations from aerobic activity by continuing to exercise regularly.

Table 1: Descriptive indicators related to research variables in pre-test and post-test

Statistical indicators Variables		number of samples	Average changes	Minimum	Maximum	Standard deviation
High-density lipoprotein (HDL) (mg/dl)	pre-test	24	41.89	29.99	24.36	7.38
	Post-test	24	44.01	33.87	56.41	6.96
	After 4 weeks of detraining	24	42.39	31.02	55.00	7.20
	After eight weeks of detraining	24	42.02	29	54	7.47
Low-density lipoprotein (VLDL) (mg/dl)	pre-test	24	24.67	14.60	50.40	9.15
	Post-test	24	21.24	13.20	43.00	7.64
	After 4 weeks of detraining	24	23.30	13.60	47.00	8.65
	After eight weeks of detraining	24	24.71	15.34	48.99	8.94
Low-density lipoprotein (LDL) (mg/dl)	pre-test	24	79.93	41.00	117.00	1.77
	Post-test	24	75.00	34.00	110.00	1.73
	After 4 weeks of detraining	24	75.25	35.00	111.00	1.72
	After eight weeks of detraining	24	79.51	40.00	118.00	1.79
(VO_{2max}) Maximum oxygen consumption	pre-test	24	45.25	38.21	50.28	3.40
	Post-test	24	52.27	42.10	58.91	4.32
	After 4 weeks of detraining	24	47.91	40.75	50.55	3.94
	After eight weeks of detraining	24	45.21	38.02	50.07	3.46

Table 2: Comparison of the average maximum oxygen consumption (VO2max) before and after eight weeks of aerobic training in female basketball premier league players

(VO_{2max}) Maximum oxygen consumption	Mean	Minimum	Maximum	Standard deviation	t-test	P
Before training	45.25	38.21	50.28	3.40	-18.818	0.001
After training	52.27	42.10	58.91	4.32		

Table 3: Comparison of average LDL, HDL, VLDL before and after eight weeks of aerobic training in female basketball players

Statistical indicators Variables		Mean	Minimum	Maximum	The standard deviation	t-test	P
Very low density lipoproteins (VLDL) (mg/dl)	Before training	24.67	14.60	50.40	9.15	7.627	0.001
	After training	21.24	13.20	43.00	7.64		
Low-density lipoprotein (LDL) (mg/dl)	Before training	79.93	41.00	117.00	1.77	10.45	0.001
	After training	75.00	34.00	110.00	1.73		
High-density lipoprotein (HDL) (mg/dl)	Before training	41.89	29.99	24.36	7.38	-6.77	0.001
	After training	44.01	33.87	56.41	6.96		

Table 4: The difference between the means of the groups in comparison with the stage after eight weeks of training and after four weeks of detraining

Statistical indicators / Difference tests	The difference between the means in the maximum oxygen consumption (VO_{2max})	Significance level
After training - after 4 weeks of detraining	4.9533	0.001

Table 5: The difference between the means of the groups in comparison with the stage after eight weeks of training and four weeks of detraining

statistical indicators / Difference tests	Mean difference			Significance level
	Low-density lipoprotein (LDL (mg/dl)	**Very low density lipoproteins (VLDL) (mg/dl)**	**High-density lipoprotein (HDL) (mg/dl)**	
After training and detraining	0.25	2.05	1.617	0.001

4. Conclusions

Aerobic power is one of the important capabilities for the successful performance of athletes which develops during the training stages and maintaining it is one of the most important tasks of coaches and athletes in different training seasons. The main factor that harms the strengthening and development of bio motor capabilities is the issue of detraining or the athlete's distance from the order and coherence of daily and appropriate exercise. The research results showed that; Eight weeks of aerobic activity had a significant increase in maximal oxygen intake and high-density lipoprotein (HDL) and a significant decrease in low-density lipoprotein (LDL) and very-low-density lipoprotein (VLDL). Also, after 4 weeks of training, adverse effects were observed on the maximum oxygen consumption of blood lipoproteins in female basketball players.

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