Women. Health. Bull. 2020; 7(4)
Published online 2020 October.

Research Article

The Effect of Six Weeks of Aerobic Training (in the Morning and Afternoon) on Some Cardiovascular Indices and Quality of Life in Drug Addicted Women

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Received July 2, 2020; **Revised** August 5, 2020; **Accepted** September 3, 2020

Abstract

Background: Addiction not only causes social and behavioral disorders but also affects various aspects of physical health, causing huge financial damages to individuals, families, and societies. Addicts have lower health and physical activity than the general population. The objective of this study was to investigate the effect of six weeks of aerobic training (in the morning and afternoon) on some cardiovascular indices and quality of life in drug addicted women.
Methods: In this semi-experimental study, we selected 30 addicted women in Bojnourd city in 2016 by convenience and purposeful sampling method and divided them into experimental (n=15) and control (n=15) groups. The training protocol comprised six weeks of aerobic training (three sessions per week in the morning and afternoon) with each session lasting 45-60 minutes with an intensity of 50-70% of maximal heart rate reserve. All participants were briefed on all study procedures and potential risks; they signed a written consent form after having read and understood the details of the experiments. We used paired sample t-test and ANCOVA to compare within and between-group variance changes; P<0.05 was considered as statistically significant.
Results: Weight (66.93±3.23 vs 65.89±3.13), body mass index (24.23±1.95 vs 23.86±1.97), body fat percentage (18.84±2.00 vs 17.96±2.03), fibrinogen (345.80±36.46 vs 338.06±38.74), and serum C-reactive protein (167.40±7.66 vs 159.80±13.96) decreased significantly at the end of the six-week aerobic training period (P<0.05). There were significant differences between the experimental and control groups regarding the mean changes of weight (P=0.001), body mass index (P=0.001), body fat percentage (P=0.005), maximal oxygen consumption (P=0.01), physical restraint (P=0.001), general health (P=0.001), vital force (P=0.004), social activity (P=0.001), physical performance (P=0.001), emotional performance (P=0.001), and life satisfaction (P=0.001).
Conclusion: Six weeks of aerobic training in the morning and afternoon is likely to improve cardiovascular health and reduce the risk of atherosclerosis in female drug addicts.

Keywords: Substance-related disorders, C-reactive protein, Quality of life

How to Cite: Koohestani A, Fathi M, Hejazi K. The Effect of Six Weeks of Aerobic Training (in the Morning and Afternoon) on Some Cardiovascular Indices and Quality of Life in Drug Addicted. Women. Health. Bull. 2020;7(4):3-10. doi: 10.30476/whb.2020.87143.1067.

1. Introduction

Addiction is referred to as physical and psychological dependence on drugs, alcohol, and tobacco. Unfortunately, most countries are involved with traditional and industrial drug addiction and gender differences in drug abuse is commonly discussed (1). Depending on the culture, addiction may exist in both sexes; however, women's addiction is highly detrimental given their crucial role in shaping the family nucleus and raising children (2). The number of addicted women is lower than that of male addicts; recent decades, however, have seen an increase in female addiction rate , with 10% of addicts being women (3, 4). It is more difficult to treat women's addiction than it is for men because there are different options to treatment of the addicted women (1). There are no accurate statistics on the number of female drug addicts in Iran; according to some surveys, women comprise about 9.6% of the country's drug addicts; based on the statistics of the Ministry of Health , there is one addicted woman for every eight addicted men (5). On the other hand, according to state prison authorities, 50% of female inmates are currently in prison for drug and drug addiction, which has increased over the years (3).

Drug abuse has profound effects on the physiological structure of the body. One of the side effects associated with drug abuse is the risk of cardiovascular disease. According to studies, inflammatory factors such as C-reactive protein and serum fibrinogen are strong indicators of cardiovascular disease (6-8). It has been reported that patients with drug addiction have higher levels of C-reactive protein and fibrinogen; this might augment the incidence of cardiovascular disease in these patients (9). C-reactive protein is a member of the pentraxin family; it is composed of five 23 kDa subunits and derived from the liver and endothelium of coronary arteries. This protein can damage the vessels and elevate the risk of atherosclerosis through increasing the adhesion molecules, reducing the nitric oxide activity, increasing the PAI-1, and stimulating macrophages to consume LDL (10, 11). Fibrinogen is a soluble protein that is converted to fibrin by thrombin and forms the basis of blood clots. Increased levels of this protein is another sign of cardiovascular risk (12, 13). Physical activity, particularly endurance-boosting exercises, plays an important role in reducing or eliminating a number of cardiovascular risk factors, including C-reactive protein levels, fibrinogen, and hypertension (14). Basically, most physical activities are useful for addiction treatment; they can provide the body with energy, including blood oxygenation (aerobic exercises), induce vitality in addicts, regulate cardiovascular factors such as the serum levels of C-reactive protein and fibrinogen and blood pressure, and enhance the quality of life (9). Drug abuse is a major threat to women's health and a costly widespread problem that can lead to irreparable consequences. Accordingly, women's addiction is of a higher importance (1). The significance of this study is that aerobic exercises can decrease the relapse in drug addiction by affecting the physical and psychological factors in addicts.

The purpose of this study was to investigate the effect of six-week aerobic training in the morning and afternoon on cardiovascular indices and quality of life in female drug addicts.

2. Methods

In the present quasi-experimental study, the experimental and control groups were compared in terms of pre-test and post-test. The statistical population consisted of 80 drug abusers who participated anonymously or incognito in drug-dependent training classes. The statistical sample of this study included 30 addicted women in Bojnourd city who were selected by convenience and purposeful sampling method. In the first stage, we explained the nature of the study. Inclusion criteria were at least 4-6 months of elapsed time since the quit date or more than two years of elapsed time from the beginning of drug abuse. The participants were dependent on only one drug (opium) and consumed 10 mg of methadone daily during their withdrawal (15). They were also not allowed to consume other substances such as codeine, morphine, and amphetamine. The subjects voluntarily took part in the research based on the conditions of the study and signed the consent form. Via random assignment by lottery, we randomly divided the samples into experimental (n=15) and control (n=15) groups. The Ethics Committee of Islamic Azad University, Bojnourd Branch, approved the present study under the Code R.IAU.BOJNOURD.REC.2017.182. According to the study plan, the control group did not participate in any other scheduled and regular exercise programs during the study period. In the primary outcome paper, we specified 15 participants per group using G*power 3.1.363 and assuming 1.25 effect size at 0.05 alpha and 0.9 power (16, 17). Effect sizes of 0.2, 0.5, and 0.8 were considered as small, medium, and large, respectively (18).

2.1. Body Composition

To measure the body composition, we measured the subjects' height with Seca height scale (Made in Germany) with 5 mm accuracy; hip and waist circumference was measured with a tape measure (Mabis / Japan) with 5 mm accuracy, and the body fat percentage and weight were measured with an accuracy of 100 gr. Waist circumference was divided by hip circumference to obtain the waist-hip ratio; body weight was divided by height squared meter to obtain body mass index (kg/m^2). All measurements were performed while the subjects had refrained from eating and drinking four hours prior to the test, and their bladder, stomach, and intestines had been emptied.

2.2. Blood Pressure

The patients were allowed to enter the design following cardiovascular examination, blood pressure measurement, and electrocardiogram recording by a specialist. Each individual's blood pressure was measured prior to physical activity using Maximed Exipres TD-3018; it was then converted to mean blood pressure using the mean arterial blood pressure formula (Equation 1).

Equation 1: mean blood pressure = (2 × diastolic blood pressure + systolic blood pressure) / 3

2.3. Maximum Oxygen Consumption

In order to estimate the maximum oxygen consumption, the participants were asked to either run as fast as they could for two minutes or walk 2400 m. after that, according to Equation 2, the maximum oxygen consumption was determined:

Equation 2: Maximum oxygen consumption = Horizontal speed (m / min) × 0.2 + 5/3

2.4. Quality of Life

We evaluated this factor based on SF36 Quality of Life Scale which is currently the most common tool. This scale has 36 questions. It measures eight subscales related to health, namely physical function (10 questions) measured at 21 levels, physical role (four questions) measured at five levels, physical pain (two questions)measured at 11 levels, general health (five questions) measured at 21 levels, vitality (four questions) measured at 21 levels, social performance (two questions) measured at nine levels, emotional role play (three questions) measured at four levels , and mental health (six questions) measured at 26 levels. The reliability coefficient of the questionnaire was estimated at 0.88 using test-retest and Cronbach's alpha test for SF36 Quality of Life Scale. To evaluate the reliability of the questionnaire, internal consistency was determined, and Cronbach's alpha was calculated. To assess the reliability of the retest, a questionnaire was administered to all participants over two stages of pre-test and post-test with a two-week interval (19).

2.5. Blood Samples

Blood samples were collected 24 h before the training session and 48 h after. The samples were taken from the left vein of each subject in sitting position and at rest; the process was performed between 8:0-10:00 a.m. after 10 to 12 hours of fasting in the laboratory. To determine serum C-reactive protein levels, nephelometry was taken using ELISA method and the human C-reactive protein kit MININEPH TM UK. To measure the fibrinogen levels, Stago machine (Germany) was used through coagulation method by an Iranian manufactured Mahsayaran kit.

2.6. Training Protocol

The training protocol consisted of six weeks of aerobic training (three sessions per week) in the morning and afternoon with each session lasting for 45-60 minutes at an intensity of 50-70% of maximal heart rate reserve; the training duration progressively increased from 30 minutes at baseline to 45 minutes at the end of the period. The training protocol consisted of general warm-up for 10 minutes (walking, moderate running, stretching, and mobility); the training intensity was controlled by a pulse meter (POLAR / Finland) (20). At the end of each session, an exercise was performed for 10 minutes to return to baseline and cool down (slow running, walking, and stretching). At the end of the protocol (after six weeks), all measurements were taken, and data were collected again as the pre-test conditions. Similar to before the study, the control group was inactive during the study period.

2.7. Statistical Analysis

Data were analyzed by SPSS 16 software. The normality of the theoretical distribution of the data was confirmed using the Shapiro-Wilk statistical test and variance homogeneity by Levene's test; next, paired sample t-test and ANCOVA were used to compare between- and within-group variance changes. Significance level was considered less than 0.05.

3. Results

Table 1 shows the characteristics of the experimental and control subjects. Based on Table 2, at the end of the six-week aerobic training, within-group mean changes in weight (P=0.001), body mass index (P=0.001), body fat percentage(P=0.005), fibrinogen (P=0.001), serum C-reactive protein decreased significantly (P=0.03); however, in the experimental group, unlike the control group, the maximal oxygen consumption at the end of the period increased significantly (P=0.001) (Figures 1 and 2).

Table 3 shows that at the end of the training period, intra-group mean changes concerning physical restraints (P=0.001), psychological health (P=0.001), general health (P=0.001), vital force (P=0.002), social activity (P=0.001), physical performance (P=0.001), emotional performance (P=0.001), and life satisfaction (P=0.001) increased significantly, but the amount of physical

Table 1: The characteristics of volunteers in this study

Groups	**Variations (Mean±SD)**				
	Age (year)	**Height (Cm)**	**Weight (Kg)**	**BMI (kg/m2)**	**Body fat percent (%)**
Experimental	29.53±6.43	166.40±4.30	66.93±3.23	24.23±1.95	18.84±2.00
Control	30.4±5.62	167.46±3.68	70.53±5.27	25.16±1.88	20.32±2.55

BMI: Body mass index; SD: Standard deviation

Table 2: The variations in body composition, fibrinogen, and C-reactive protein levels in addicted women					
Variables	**Groups**	**Variations**			
		Stages		**P value****	**P value*****
		Pre-test mean±SD*	**Post-test mean±SD***	**P**	**P**
Weight (kg)	Experimental	66.93±3.23	65.89±3.13	0.001‡	0.001‡
	Control	70.53±5.27	70.55±5.48	0.91	
BMI (kg/m2)	Experimental	24.23±1.95	23.86±1.97	0.001‡	0.001‡
	Control	25.16±1.88	25.16±1.94	0.92	
BFP (%)	Experimental	18.84±2.00	17.96±2.03	0.001‡	0.005‡
	Control	20.32±2.55	20.68±2.69	0.34	
Fibrinogen (mg/dl)	Experimental	345.80±36.46	338.06±38.74	0.001‡	0.133
	Control	343.33±42.68	346.86±38.67	0.62	
C-reactive protein (mg/l)	Experimental	167.40±7.66	159.80±13.94	0.03‡	0.409
	Control	158.73±11.48	156.06±10.66	0.10	
Systolic blood pressure (Mm Hg)	Experimental	12.26±1.09	11.86±0.83	0.16	0.252
	Control	12.06±1.09	12.20±1.20	0.68	
Diastolic blood pressure (Mm Hg)	Experimental	8.73±0.70	8.40±0.50	0.17	0.726
	Control	8.73±0.70	8.46±0.51	0.16	
Vo2max (ml/kg/min)	Experimental	44.13±3.85	47.00±4.15	0.01‡	0.01‡
	Control	47.20±4.73	45.80±4.84	0.07	

*Data presented as mean ± standard deviation, ** Paired sample t-test, ‡The mean difference is significant at the 0.05 level, *** P value between group (ANCOVA), Vo2max: Maximum rate of oxygen consumption; BMI: Body mass index; BFP: Body fat percent

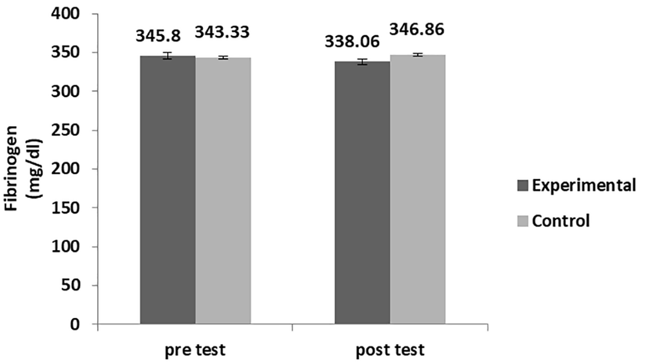

Figure 1: Changes of fibrinogen levels in addicted women

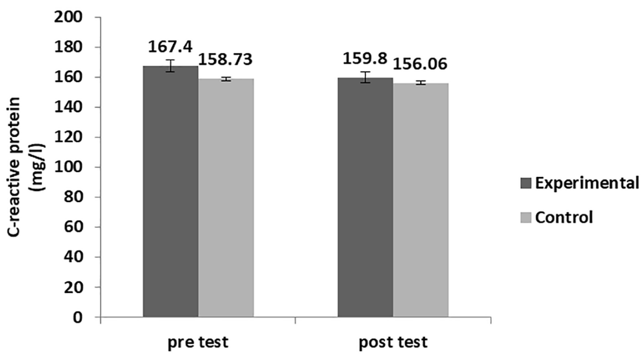

Figure 2: Changes of C-reactive protein levels in addicted women

pain (P=0.003) decreased significantly in addicted women. Furthermore, the results of Tables 2 and 3 show the between-group mean changes in the variables of weight (P=0.001), body mass index (P=0.001), body fat percentage (P=0.005), maximal oxygen consumption (P=0.01), physical restraint (P=0.001), general health (P=0.001), vital force (P=0.004), social activity (P=0.001), physical performance (P=0.001), emotional performance (P=0.001), and life satisfaction (P=0.001).

4. Discussion

The objective of this study was to investigate the effect of six-week aerobic training in the morning and afternoon on the serum levels of C-reactive protein, fibrinogen, and quality of life in female drug addicts. Aerobic training significantly reduced the serum C-reactive protein levels, which is consistent with the findings of Vidyasagar et al. (21) but inconsistent with those of Swift et al. (22). Vidyasagar et al. compared the effects of three different types of exercise intensity on serum C-reactive protein levels. They found that after eight weeks of training, serum C-reactive protein levels significantly decreased in all three groups at different intensities (21). In this study, the training protocol might have reduced the C-reactive protein by lowering the fat mass as an anti-atherogenic and risk factor in the experimental group. Improved endothelial structure and reduce this sentence is problematic in the whole. Consider revision.

Mononuclear blood cells are among the mechanisms of C-reactive protein reduction after exercise (23). Several studies on the relationship between weight loss and inflammation (C-reactive protein) have reported

Table 3: The variations in the life style of addicted women

Variables	Groups	Variations			
		Stages		P value**	P value***
		Pre-test mean±SD*	Post-test mean±SD*	P	P
Physical restraints	Experimental	68.46±4.76	73.93±4.25	0.001‡	0.001‡
	Control	70.33±4.04	69.40±3.73	0.39	
Physical pain	Experimental	73.33±1.71	72.60±1.99	0.003‡	0.342
	Control	70.40±3.06	71.46±3.92	0.30	
Psychological	Experimental	70.40±0.91	71.40±0.98	0.001‡	0.003‡
	Control	70.20±1.42	70.06±1.38	0.83	
General health	Experimental	53.00±1.96	55.86±2.50	0.001‡	0.001‡
	Control	55.00±2.32	54.73±3.99	0.70	
Vital force	Experimental	61.73±2.84	64.33±3.13	0.002‡	0.004‡
	Control	62.20±2.90	61.46±3.20	0.39	
Social activity	Experimental	81.20±2.17	83.60±2.09	0.001‡	0.001‡
	Control	80.86±2.35	80.80±2.51	0.86	
Physical performance	Experimental	80.80±4.79	86.13±4.25	0.001‡	0.001‡
	Control	81.20±4.36	82.80±4.10	0.10	
Emotional performance	Experimental	83.33±3.03	88.13±2.87	0.001‡	0.001‡
	Control	81.93±4.86	81.06±4.43	0.001‡	
Life satisfaction	Experimental	71.86±2.03	75.80±2.59	0.001‡	0.001‡
	Control	73.26±2.37	72.73±2.71	0.16	

*Data presented as mean±standard deviation, ** Paired sample t-test, ‡The mean difference is significant at the 0.05 level, *** P value between group (ANCOVA)

that fat mass reduction is a contributing factor in reducing C-reactive protein. In this vein, it has been proposed that a weight loss of at least 3.5 kg is required for anti-inflammatory effects. Therefore, seemingly, the weight loss observed in the experimental group alone might have led to the decrease in C-reactive protein (24). Our findings further support the view that decreased C-reactive protein is associated with improved symptoms of metabolic syndrome, including blood lipid profile, insulin resistance, and abdominal fat (25). The reduction mechanism of C-reactive protein following weight loss is not clear. A new hypothesis is that macrophages absorbed from the circulation by the adipose tissue of obese individuals are a major source of interleukin-6 inflammatory factor and necrosis factor-alpha (26). Physical activity, on the other hand, has been shown to decrease macrophage infiltration into adipose tissue. Accordingly, it is held that exercise reduces the generation of inflammatory factors by adipose tissue via decreasing adipose mass and macrophage infiltration (27). The discrepancies between the findings can be attributed to the training method and the subjects of these two studies. In line with Bargharar et al. and Dehghan et al., our results showed that fibrinogen levels significantly decreased at the end of the six-week program(28, 29). However, these findings are inconsistent with Ghazalian et al. and Amiri et al. (30, 31). Several mechanisms may justify the reduced fibrinogen in the subjects of the current study. Fibrinogen has a direct relationship with stress, obesity, and low-density lipoprotein and an inverse association with high-density lipoprotein. Therefore, the increase in HDL-C and the reduction in LDL-C, stress, and body fat percentage resulting from aerobic training can decrease the fibrinogen (32). Also, regular aerobic training can lower the fibrinogen concentrations in the blood through reducing catecholamine stimulation, increasing the blood flow to the muscles, and augmenting the overall blood volume (33). The decreased body fat percentage in the subjects of the present study lead to decrease the interleukin-6 made in adipose tissue, and since interleukin-6 is a stimulant of fibrinogen synthesis, its decrease results in reduced fibrinogen (33, 34). In general, too much fat can cause inflammation in the body, which is a stimulus to increased blood fibrinogen. Reducing the amount of fibrinogen synthesized as a result of long-term exercise is another mechanism for decreasing fibrinogen levels (35). Therefore, the decrease in the fibrinogen and C-reactive protein of the subjects in this study might be due to anti-inflammatory and anti-oxidative adaptations. It can be generally deduced that regular aerobic training combined with weight loss may decrease fibrinogen levels by reducing adipokines such as leptin and interleukin-6. We did not fully control for the subjects' diet, emotion, and anxiety, individual differences in genetic and hereditary characteristics in measuring some indices and mental and psychological differences of the subjects at training sessions, and the likelihood of illness or injury when conducting the research. This might be considered as the limitation of the present study.

The quality of life increased significantly in the female drug addicts of our study. Regular physical activity in addicted women can greatly reduce the destructive effect of addiction on their body, thereby increasing their psychological self-concept (36). One of the most important non-physical benefits of physical activity is its social dimension. During exercise, addicts inevitably interact with other people with whom they may have many things in common. In this way, they develop a sense of belonging to a group of friends feel less alone. This process is called socialization, which is one of the multidimensional dimensions of the quality of life (37). Another psychological benefit of exercise is that it enhances the self-esteem and confidence because one feels that their ability is at the same level with other people (37). The inconsistencies between these findings and other studies might be ascribed to the differences in the duration and training level of the subjects; in this study, the intensity of training was low and it was performed both in the morning and afternoon.

5. Conclusion

Overall, our six-week aerobic training in the morning and afternoon improved the cardiovascular health and reduced the risk of atherosclerosis in female drug addicts by increasing the quality of life and reducing body composition indices such as weight, body mass index, body fat percentage, fibrinogen, and C-reactive protein. Therefore, it is recommended that aerobic training is performed in the morning and afternoon to prevent the adverse effects of atherosclerosis.

Acknowledgements

The authors would like to thank the members of the exercise physiology department for their suggestions and help in the research.

Ethical Approval

The present study was approved by the Ethics Committee of Islamic Azad University, Bojnourd Branch under the Code R.IAU.BOJNOURD.REC.2017.182.

Funding: This work was not supported by any organization.

Conflicts of interest: None to declare.

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