

Does a Course of Aerobic Training Affect the Inflammatory Status and Cardiometabolic Risk Factors of Hookah-smoker Women? Results of a Cross-sectional Study

Abbas Saremi¹, Mohammad Parastesh¹, Manijeh Tavangar¹

Original Article

Abstract

Background: Hookah consumption is a major risk factor for inflammation and cardiovascular diseases (CVDs). The aim of this study was to evaluate the effects of two-month aerobic training on metabolic profile and serum C-reactive protein (CRP) levels in hookah-smoker women.

Methods: In this quasi-experimental study with a pretest-posttest design, 22 hookah-smoker women (at least twice a week) matched in terms of age (27.82 ± 3.81 years) and body mass index (BMI) (26.66 ± 5.92 kg/m²) were recruited and randomly divided into two groups of smokers + aerobic exercise (n = 11) and smokers (n = 11). A matched control group of non-smoker women (n = 10, age: 27.11 ± 2.71 years, BMI: 26.20 ± 2.39 kg/m²) were also recruited for baseline comparison. The aerobic exercise program was performed three days a week, 35-50 minutes a day for 8 weeks. The smokers' group were asked to continue their normal lives. Serum levels of CRP and metabolic risk factors were measured before and after the intervention. Data were analyzed using repeated measures analysis of variance (ANOVA).

Findings: At baseline, non-smoker participants had significantly better CRP level (P = 0.001) and maximal oxygen consumption (VO₂max) (P = 0.020) than hookah-smoker women. After 8 weeks of aerobic exercise, no significant change was observed in the lipid profile of hookah-smoker women (P > 0.050). Simultaneously, body weight (P = 0.030), VO₂max (P = 0.001), and CRP levels (P = 0.010) improved significantly in response to aerobic exercise.

Conclusion: These findings suggest that a course of aerobic exercise program improves the aerobic fitness of hookah-smoker women. This improvement is associated with reduction of CRP without significant changes in plasma lipid profile.

Keywords: Exercise; Inflammation; Water pipe smoking; Women

Citation: Saremi A, Parastesh M, Tavangar M. Does a Course of Aerobic Training Affect the Inflammatory Status and Cardiometabolic Risk Factors of Hookah-smoker Women? Results of a Cross-sectional Study. *Addict Health* 2022; 14(1): 26-34.

Received: 23.08.2021

Accepted: 27.10.2021

1- Department of Exercise Physiology, School of Sport Sciences, Arak University, Arak, Iran
Correspondence to: Abbas Saremi; Department of Exercise Physiology, School of Sport Sciences, Arak University, Arak, Iran;
Email: a-saremi@araku.ac.ir

Introduction

Unlike smoking, there are currently no significant general restrictions on hookah use. This practice has emerged as a popular social activity among different populations. Lack of general knowledge about the potential for addiction, as well as the individual health risks associated with hookah use, may contribute to its social acceptance, especially compared to cigarette smoking. Therefore, hookah consumption in the world, including Iran, especially among young people and women, is increasing rapidly.¹ Hookah smoke contains compounds such as carbon monoxide, benzene, polycyclic aromatic hydrocarbons (PAHs), carbonyls, phenols, phenol derivatives, etc., which are involved in causing chronic cardiovascular disease (CVD), lung disease, and cancer by activating inflammatory pathways and oxidative stress.² Although it has been well established that smoking is an important independent risk factor for CVD, including atherosclerotic vascular disease, myocardial infarction (MI), unstable angina, sudden cardiac death, and stroke, information on the cardiovascular effects of hookah consumption is very limited. In other words, despite the widespread use of hookah, few studies have been conducted so far on its adverse cardiovascular consequences.³ This lack of information is due to the fact that hookah is more of a non-Western habit and its high prevalence is a relatively new phenomenon; and since most hookah consumers also smoke cigarette, it is difficult to isolate their effects. Therefore, more experimental studies are needed to investigate the pathophysiological mechanisms and underlying effects of hookah abuse on CVD.⁴ Human and animal studies show well that hookah use is related with increased systemic inflammatory markers such as interleukin-6 (IL-6), IL-1, and tumor necrosis factor alpha (TNF- α), and in fact, some of the harmful effects of hookah are associated with increased levels of inflammatory factors.^{5,6} C-reactive protein (CRP) is a stable biomarker of systemic inflammation that is produced in response to inflammatory cytokines, IL-6 and TNF- α , in the liver. Evidence shows that CRP is a strong predictor of CVD and its circulatory levels are high in obese people, cigarette smokers, and hookah consumers.⁷ Therefore, it has been suggested that decreased CRP levels are

associated with decreased cardiovascular risk and other related chronic diseases.⁸

On the other hand, the promotion of health through exercise and physical activity has been well established as an important lifestyle factor in delaying some pathological conditions such as heart attacks and strokes, MI, cancer, and diabetes. In several studies, the effects of exercise on the inflammatory status of individuals at high levels of metabolic problems such as obesity and diabetes have been investigated and it has been suggested that moderate-intensity exercise has beneficial effects on the pathogenesis of many diseases, including CVD.^{9,10} In an animal model, Nakhaee et al. showed that 8 weeks of endurance training prevented hookah smoking-induced cardiac dysfunction partly via improvement of antioxidants and attenuation of pro-inflammatory cytokines.¹¹ In another study, Nakhaee et al. found that a period of swimming training may attenuate lung damage in animals exposed to hookah smoke by improving the antioxidant and inflammatory status of the lungs.¹² Therefore, due to the increasing use of hookah and its side effects, it seems that more studies are needed on various aspects related to its health as well as modulating factors (including exercise). Therefore, researchers decided, for the first time, to study the effect of a two-month period of aerobic exercise on metabolic and inflammatory parameters of hookah consumers. However, given that it is not possible for many individuals to quit smoking, the main question of the present study is whether exercising while smoking a hookah can play a protective role against its destructive effects, including chronic inflammation.

Methods

In this cross-sectional study (from September to December 2019), 22 non-trained adult women (the mean age of 27.82 ± 3.81 years old) living in Arak, Iran, who had a history of smoking hookah for at least 2 years were purposefully selected from 28 volunteers (according to inclusion and exclusion criteria). The number of samples was selected using G*Power software version 3.1.9.9, considering alpha of 0.05 and statistical power of 0.90. Participants were recruited through the installation of announcements in health and recreation centers. The tobacco used by these women was Mouassa, which according to

sources, the amount of nicotine is about 3.4 mg/g.¹³ The samples were then randomly divided into two groups of smokers + aerobic exercise (n = 11) and smokers (n = 11). To compare hookah-smoker women with non-smoker women, a similar group of women without a history of hookah and cigarette use were recruited at the baseline level [n = 10, age: 27.11 ± 2.71 years, body mass index (BMI): 26.20 ± 2.39 kg/m²]. The Ethics Committee of Islamic Azad University, Boroujerd Branch, Boroujerd, Iran, approved the study protocols (IR.IAU.B.REC.1398.019). All eligible women provided informed written consent before entering the study. Inclusion criteria were: women in the age range of 20 to 30 years who had at least two years of history of hookah use (twice per week for 20 to 40 minutes) and their BMI was between 20 to 30 kg/m². In addition, women with medical disorders such as asthma and allergies, infections, diabetes, high blood pressure, cancer, heart disease, hypothyroidism and hyperthyroidism, cigarette smoking at the same time, regular exercise for the past 6 months, reluctance to continue cooperation, and absence more than two consecutive practice sessions or three sessions during the study were excluded from the study.

Training program: All training sessions were conducted under the supervision of a researcher in the Sports Science Laboratory of Arak University. All exercises were performed on a treadmill at a temperature of 27-29 °C. One week before the start of the study, the subjects first participated in a familiarization session and learned how to properly perform the exercise on a treadmill. The training program was 3 days per week for 2 months with 48 hours of rest between sessions. All training sessions began with 10 minutes of warm-up and stretching. The training program was based on the recommendations of the American College of Sports Medicine (ACSM)

for healthy adults.¹⁴ The heart rate for determining the intensity of exercise was estimated by counting heartbeats using polar telemetry and the maximum heart rate (HRmax) was estimated based on the formula of 220 minus age. In the first week, the subjects performed the exercise for 15 minutes with an intensity of 30% HRmax. The second week of the program consisted of 15 minutes with an intensity of 35% HRmax. In the third and fourth weeks, the subjects trained for 20 minutes with an intensity of 40%-45% HRmax. The fifth and sixth weeks consisted of 25 minutes with an intensity of 50%-55% HRmax and in the seventh and eighth weeks, the subjects practiced for 30 minutes with an intensity of 60%-65% HRmax (Table 1). During menstruation, the intensity of exercise was reduced by 5 to 10 percent. The control group was asked to maintain their normal activity during the study and not to participate in any special training program.

Measurements: At the beginning of the study, general information such as age, weight, height, and BMI was recorded. Weight was measured using a Seca scale with an accuracy of 100 g and height was measured using a tape with an accuracy of 0.1 cm. BMI was determined by dividing weight by height in square meters. The waist circumference (WC) was measured using a flexible non-extensible plastic tape. The tape was placed above the iliac crest parallel to the ground. Subjects' subcutaneous fat thickness was measured using a caliper at three points on the triceps, abdomen, and suprailiac on the right side of the body to determine the percentage of fat. Fat percentage was determined using Jackson and Pollock formula (triceps, suprailiac, and thigh):

$$\text{Body density} = 1.0994921 - (0.0009929 \times \text{sum of skinfolds}) + (0.0000023 \times \text{square of the sum of skinfolds}) - (0.0001392 \times \text{age})$$

$$\text{Body fat percentage} = (495/\text{body density}) - 450^{15}$$

Table 1. Summary of the aerobic exercise program performed

Intervention period (week)	Running time (minute)	Exercise intensity (%HRmax)	Repetition in week
1	15	30	3
2	15	35	3
3	20	40	3
4	20	45	3
5	25	50	3
6	25	55	3
7	30	60	3
8	30	65	3

HRmax: Maximum heart rate

Maximum aerobic capacity was measured using Cooper field test 48 hours before and after training. In this test, the subject tries to run the maximum possible distance in 12 minutes by running and walking. The amount of distance traveled in the mentioned time determines the subject's score: Maximal oxygen consumption (VO_{2max}) = (the covered distance-504.9)/44.73.¹⁵ A demographic questionnaire was also used to collect data.

Blood sampling and analysis: Blood sampling was performed in two stages, one day before the first training session (pre-test) and 48 hours after the last training session in the eighth week and after 10 to 12 hours of fasting (between 6-7 in the morning). After blood collection, the samples were stored for 20 minutes at 3000 rpm in centrifuge and isolated serum at -80 °C. Glucose, total cholesterol, high-density lipoprotein cholesterol (HDL-C), and triglyceride (TG) were assessed by enzymatic colorimetric method (Pars Azmoon Company Kit, Iran). Low-density lipoprotein cholesterol (LDL-C) was determined by the formula of Friedewald ($LDL-C = TC - HDL-C - TG/5$). Sensitivity of total cholesterol, HDL-C, TG, and glucose was 3, 1, 1, and 5 mg/dl, respectively. Measurement of CRP level was performed by enzyme linked immunosorbent assay (ELISA) method (Pars Azmoon Company Kit, Iran). The intra-assay and inter-assay coefficients of variation of CRP were 2.5% and 3.9%, respectively.

After data collection, SPSS software (version 18, SPSS Inc., Chicago, IL, USA) was used for data analysis. Descriptive statistics were used to calculate the mean and Shapiro-Wilk test was used to determine the normal distribution of data. The two groups of smokers were first combined into one group, then differences between hookah-smoker women and non-smoker women were examined using an independent samples t-test. Changes in the dependent variables resulting from the exercise intervention were assessed by two-way (time × group) repeated-measures

analysis of variance (ANOVA). Significance level in all tests was considered 0.05.

Results

Table 2 summarizes the basic clinical, demographic, and functional characteristics of the study participants. In the present study, 32 women participated and 31 of them completed the study. One person in the control group was excluded from the study due to unwillingness to continue working. VO_{2max} was higher for the non-smoker women than the hookah-smoker women ($P = 0.020$). The non-smoker women also had lower baseline total cholesterol ($P = 0.020$) and LDL-C ($P = 0.030$) than the hookah-smoker women (Table 2). CRP concentration was higher in the hookah-smoker women than the non-smoker women ($P = 0.001$) (Figure 1).

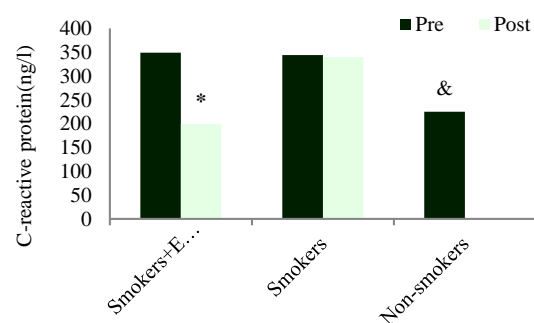


Figure 1. Comparison of C-reactive protein (CRP) levels before and after exercise intervention between study groups [&Significant ($P < 0.05$) difference between smoker and non-smoker women; *Significant ($P < 0.05$) difference between pre- and post-intervention]

Table 3 shows the metabolic characteristics of the subjects. The smokers + exercise group completed at least 96% of the exercise sessions. After 8 weeks of the aerobic training, the exercise group experienced weight loss ($P = 0.030$), which was accompanied by significant improvements in BMI ($P = 0.020$), WC ($P = 0.030$), body fat percentage ($P = 0.010$), and VO_{2max} ($P = 0.001$) (Table 3).

Table 2. Demographic characteristics of the subjects

Variable	Smokers + exercise (n = 11)	Smokers (n = 10)	Non-smokers (n = 10)
Age (year)	28.16 ± 3.12	27.49 ± 4.36	27.11 ± 2.71
Hookah use period (year)	3.22 ± 0.81	3.42 ± 0.62	-
Hookah use repetition (time/week)	3.50 ± 0.41	3.20 ± 0.32	-
Weight (kg)	70.16 ± 4.23	69.74 ± 4.69	69.40 ± 3.55
BMI (kg/m^2)	26.71 ± 6.28	26.61 ± 5.21	26.20 ± 2.39
Body fat percent	25.81 ± 4.18	25.71 ± 4.32	25.61 ± 4.28
VO_{2max} (ml/kg/min)	22.55 ± 3.39	21.86 ± 4.28	25.24 ± 3.59

The values are presented as mean ± standard deviation (SD)

BMI: Body mass index; VO_{2max} : Maximal oxygen consumption

Table 3. Comparison of metabolic profile of subjects before and after exercise intervention

Variable	Smokers + exercise (n = 11)		Smokers (n = 10)		Non-smokers (n = 10)
	Before	After	Before	After	
Weight (kg)	70.16 ± 4.23	68.12 ± 4.23*	69.74 ± 4.69	69.87 ± 4.55	69.40 ± 3.55
BMI (kg/m ²)	26.71 ± 6.28	25.77 ± 4.24*	26.61 ± 5.21	26.66 ± 5.25	26.20 ± 2.39
WC (cm)	82.65 ± 5.42	79.65 ± 5.56*	83.19 ± 6.58	83.22 ± 6.51	82.86 ± 5.78
Body fat percent	25.81 ± 4.18	23.41 ± 4.29*	25.71 ± 4.32	25.76 ± 4.66	25.61 ± 4.28
VO ₂ max (ml/kg/min)	22.55 ± 3.39	29.25 ± 3.40*	21.86 ± 4.28	21.94 ± 3.78	25.24 ± 3.59 ^{&}
Glucose (mg/dl)	87.66 ± 9.65	84.46 ± 13.60	85.28 ± 10.11	85.31 ± 11.23	86.10 ± 9.25
TG (mg/dl)	101.50 ± 10.21	100.83 ± 9.74	105.12 ± 9.11	106.81 ± 11.39	102.10 ± 8.20
Cholesterol (mg/dl)	161.00 ± 19.25	159.13 ± 24.12	157.69 ± 18.40	158.28 ± 20.55	146.25 ± 19.20 ^{&}
LDL (mg/dl)	121.75 ± 17.31	115.15 ± 18.87	118.85 ± 21.33	119.63 ± 23.12	104.55 ± 18.31 ^{&}
HDL (mg/dl)	47.66 ± 6.56	50.16 ± 7.21	46.54 ± 5.43	46.30 ± 7.42	47.44 ± 7.18

The values are presented as mean ± standard deviation (SD)

*Significant ($P < 0.05$) difference between pre- and post-intervention, [&]Significant ($P < 0.05$) difference between smoker and non-smoker women

BMI: Body mass index; WC: Waist circumference; VO₂max: Maximal oxygen consumption; TG: Triglyceride; LDL: Low-density lipoprotein; HDL: High-density lipoprotein

There were no significant differences in TG ($P = 0.390$), total cholesterol ($P = 0.420$), LDL-C ($P = 0.320$), HDL-C ($P = 0.180$), and blood glucose ($P = 0.110$) between smokers + exercise and smokers groups during the course of the 8-week aerobic training program. In addition, it was observed that after 8 weeks of aerobic training, a significant decrease in the amount of CRP occurred ($P = 0.010$) (Figure 1).

Discussion

The main finding of the present study was that in women who use hookah, aerobic fitness and CRP levels are in poor condition, and performing 8 weeks of aerobic exercise with an intensity of 30% to 65% of HRmax is associated with a relative improvement in these factors.

Recent studies show that hookah use, along with an increase in inflammatory factors, leads to cardiovascular complications such as hypertension (HTN), thrombotic obstruction, increased fibrinogen, elevated plasminogen activator inhibitor 1 (PAI-1) (an important factor in the pathogenesis of several CVDs), and increased blood adhesion.^{16,17} In this regard, several animal and human studies have reported that hookah use is associated with increased inflammatory factors such as IL-6, TNF- α , and CRP, and it has been suggested that these inflammatory factors play an important role in the pathogenesis of CVD.¹⁸ In the present study, we found that at baseline, hookah-smoker women had higher circulating concentrations of CRP than non-hookah-smoker women. The results of our

study are consistent with those of Alnashwan et al.² Indeed, these findings support the belief that hookah use is associated with increased systemic inflammation.¹⁹ However, it should be noted that these inflammatory responses are strongly influenced by the amount of inhaled nicotine, duration, and frequency of hookah use.²⁰

Blood lipids are an integral part of the search for cardiovascular risk factors. Previous studies have shown that cigarette smoking or hookah smoking significantly increases LDL-C and is associated with high TG concentrations and decreased HDL-C.²¹ Consistent with this evidence, the present study also found that total cholesterol and LDL-C levels were higher in hookah-smoker women than in non-hookah-smoker women. Therefore, hookah smoking seems to be a risk factor for dyslipidemia and thus, possibly increases the risk of CVD. In contrast, physical activity and exercise have been introduced as an effective non-pharmacological solution to improve blood lipid profile. For example, Farbod et al. found that a 12-week aerobic training was associated with improved metabolic status and blood lipid profile of overweight middle-aged women.²² In the current study, it was observed that after aerobic program, there was no significant change in the variables of blood lipid status of the subjects. However, in line with the present study, Colombo et al. showed that a short period of aerobic exercise in women with metabolic syndrome did not have a significant effect on blood lipid profile including cholesterol, TG, and LDL-C.²³ This absence of

change may be due to the lack of control over the subjects' diet and the increase in appetite of cigarette smokers and hookah smokers after starting exercise. Because the evidence is that the decrease in body mass and the consequent improvement in blood lipids occur when the body's energy balance is negative.⁸ On the other hand, according to the data from the present study, it seems that if the exercise program was continued, we would probably see more weight loss and improved metabolic profile, because in the majority of studies that have reported improved lipid profile without diet and only with exercise, the minimum intervention period was 12 weeks.^{22,24}

In addition, the implementation of appropriate strategies to improve the inflammatory status in various conditions such as obesity, diabetes, heart disease, and addiction in recent years has been considered by health researchers.^{8,25} In this regard, exercise and physical activity have always been discussed, although the findings on the response of the inflammatory profile to exercise in different populations seem somewhat controversial. While several review articles have shown that exercise has a beneficial effect in reducing inflammation in individuals with chronic diseases such as cancer, heart disease, and diabetes,⁹ however, there is no consensus on the effect of regular exercise on inflammatory markers in relatively healthy adults.²⁵ In the present study, we found that after 8 weeks of aerobic exercise, the level of CRP in hookah-smoker women decreased. Although according to evaluation of researchers, no similar study has been performed on hookah-smoker women, in line with our findings, Januszek et al. found that 12 weeks of moderate-intensity aerobic exercise had no effect on cardiovascular markers including TG, cholesterol, and HDL in overweight women, but serum CRP levels were significantly reduced.²⁶ In contrast, some researchers have not confirmed the positive effects of exercise on inflammatory markers. For example, in one study, 6 months of aerobic exercise did not alter the inflammatory cytokines IL-6, CRP, and TNF- α in overweight or obese women.²⁷ Possible reasons for this discrepancy were related to differences in the type of exercise (e.g., aerobic versus resistance), differences between study participants (e.g., age, sex, health status, and basal

inflammation), differences in exercise protocols (e.g., severity, frequency, and duration of intervention), or the dissemination of poor findings. Some studies have attributed the modification of cardiovascular risk factors or inflammatory status to weight loss or body fat percentage resulting from an exercise program, because even long-term exercise in the absence of weight loss does not affect the level of inflammatory cytokines and cardiovascular risk factors.²² It is noteworthy that, unlike the blood lipid profile, which has been suggested to improve with at least 10% weight loss, the improvement in inflammatory status usually occurs sooner, and even 5% weight loss is associated with a decrease in CRP.²⁸ Several mechanisms have been proposed for the reduction of CRP after exercise, including the reduction of inflammatory cytokines such as IL-6, the reduction of visceral fat mass, the improvement of insulin resistance, and the antioxidant effects of exercise.^{29,30} However, based on the limited data in the present study, it is not possible to diagnose the possible mechanism of CRP reduction following aerobic exercise in hookah-smoker women.

One limitation in the present study was that the diet was not controlled during the intervention period. However, it was best for participants to follow the same diet 3 days before each blood sample and during the training period. Another limitation of the present study is the small number of samples; therefore, it is recommended to conduct more studies with larger sample sizes and longer time periods to achieve more accurate results.

Conclusion

The results of this study indicate that 2 months of aerobic exercise, independent of the effect on blood lipid profile, may be associated with a decrease in CRP and improvement in cardiometabolic risk factors in hookah-smoker women. Therefore, it is suggested that changes in lifestyle and physical activity be considered as one of the health priorities in hookah smokers, so that at least some of their destructive effects are reduced.

Conflict of Interests

The Authors have no conflict of interest.

Acknowledgements

This work was supported by Arak University Research Center. The authors thank the participants and laboratory assistants at the Clinical Laboratory Center of Arak University who assisted with data collection and analysis.

Authors' Contribution

Design of the study: AS and MT; acquisition of data: MT; analysis and interpretation: MP; drafting of manuscript: AS and MT; critical revision: MP.

References

1. Khodadost M, Maajani K, Abbasi-Ghahramanloo A, Naserbakht M, Ghodusi E, Sarvi F, et al. Prevalence of hookah smoking among university students in Iran: A meta-analysis of observational studies. *Iran. J. Public Health* 2020; 49(1): 1-13.
2. Alnashwan A, Hakamy A, Gongol B, Alismail A, Horn M, Marin T. Exhaled biomarkers of oxidative stress and inflammation in hookah smokers: A public health concern. *Gratis J Cancer Biol Therap* 2015; 1(1): 29-37.
3. Qasim H, Alarabi A, Alzoubi K, Karim Z, Alshbool F, Khasawneh F. The effects of hookah/waterpipe smoking on general health and the cardiovascular system. *Environ Health Prev Med* 2019; 24(1): 58.
4. Bhatnagar A, Maziak W, Eissenberg T, Ward K, Thurston G, King B, et al. Water pipe (Hookah) smoking and cardiovascular disease risk: A scientific statement from the American Heart Association. *Circulation* 2019; 139(19): 917-36.
5. Khan NA, Lawyer G, McDonough S, Wang Q, Kassem NO, Kas-Petrus F, et al. Systemic biomarkers of inflammation, oxidative stress and tissue injury and repair among waterpipe, cigarette and dual tobacco smokers. *Tob Control* 2020; 29(Suppl 2): s102-s109.
6. Nemmar A, Yuvaraju P, Beegam S, Ali BH. Short-term nose-only water-pipe (shisha) smoking exposure accelerates coagulation and causes cardiac inflammation and oxidative stress in mice. *Cell Physiol Biochem* 2015; 35(2): 829-40.
7. Avan A, Tavakoly Sany SB, Ghayour-Mobarhan M, Rahimi HR, Tajfard M, Ferns G. Serum C-reactive protein in the prediction of cardiovascular diseases: Overview of the latest clinical studies and public health practice. *J Cell Physiol* 2018; 233(11): 8508-25.
8. Saremi A, Khalaji H, Momeni S. Effect of resistance training on serum level of C-reactive protein (CRP) and fibrinogen in male addicts. *Research on Addiction* 2016; 9(36): 111-24. [In Persian].
9. Pedersen BK. Anti-inflammatory effects of exercise: Role in diabetes and cardiovascular disease. *Eur J Clin Invest* 2017; 47(8): 600-11.
10. Knudsen SH, Pedersen BK. Targeting inflammation through a physical active lifestyle and pharmaceuticals for the treatment of type 2 diabetes. *Curr Diab Rep* 2015; 15(10): 82.
11. Nakhaee MR, Joukar S, Zolfaghari MR, Rostamzadeh F, Masoumi-Ardakani Y, Iranpour M, et al. Effects of endurance exercise training on cardiac dysfunction induced by waterpipe tobacco smoking. *Addict Health* 2019; 11(2): 100-9.
12. Nakhaee MR, Zolfaghari MR, Joukar S, Nakhaee N, Masoumi-Ardakani Y, Iranpour M, et al. Swimming exercise training attenuates the lung inflammatory response and injury induced by exposing to waterpipe tobacco smoke. *Addict Health* 2020; 12(2): 109-17.
13. Hadidi KA, Mohammed FI. Nicotine content in tobacco used in hubble-bubble smoking. *Saudi Med J* 2004; 25(7): 912-7.
14. Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA, et al. Physical activity and public health: Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Med Sci Sports Exerc* 2007; 39(8): 1423-34.
15. American College of Sports Medicine. ACSM's Health-related physical fitness assessment manual. Philadelphia, PA: Lippincott Williams & Wilkins Health; 2015.
16. Taati B, Arazi H, Suzuki K. Oxidative stress and inflammation induced by waterpipe tobacco smoking despite possible protective effects of exercise training: A review of the literature. *Antioxidants* 2020; 9(9): 777-82.
17. Badran M, Laher I. Waterpipe (shisha, hookah) smoking, oxidative stress and hidden disease potential. *Redox Biology* 2020; 34: 101455.
18. Conklin DJ, Schick S, Blaha MJ, Carll A, DeFilippis A, Ganz P, et al. Cardiovascular injury induced by tobacco products: assessment of risk factors and biomarkers of harm. A Tobacco Centers of Regulatory Science compilation. *Am J Physiol Heart Circ Physiol* 2019; 316(4): H801-H827.
19. Nemmar A, Raza H, Yuvaraju P, Beegam S, John A, Yasin J, et al. Nose-only water-pipe smoking effects on airway resistance, inflammation, and oxidative stress in mice. *J Appl Physiol* (1985) 2013; 115(9): 1316-23.

20. Al-Sawalha NA, Migdadi AM, Alzoubi KH, Khabour OF, Qinna NA. Effect of waterpipe tobacco smoking on airway inflammation in murine model of asthma. *Inhal Toxicol* 2017; 29(2): 46-52.
21. Saffar SS, Darroudi S, Tayefi M, Nosrati TA, Moohebat M, Ebrahimi M, et al. Hookah smoking is strongly associated with diabetes mellitus, metabolic syndrome and obesity: A population-based study. *Diabetol Metab Syndr* 2018; 10: 33.
22. Farbod M, Eizadi M, Rashidi M, Mirakhori Z. Effects of aerobic training with no caloric restriction on serum resistin and lipid profile in inactive overweight women. *Int J Basic Sci Med* 2020; 5(1): 9-15.
23. Colombo CM, de Macedo RM, Fernandes-Silva MM, Caporal AM, Stingen AE, Costantini CR, et al. Short-term effects of moderate intensity physical activity in patients with metabolic syndrome. *Einstein (Sao Paulo)* 2013; 11(3): 324-30.
24. Mann S, Beedie C, Jimenez A. Differential effects of aerobic exercise, resistance training and combined exercise modalities on cholesterol and the lipid profile: Review, synthesis and recommendations. *Sports Med* 2014; 44(2): 211-21.
25. Suzuki K. Chronic Inflammation as an immunological abnormality and effectiveness of exercise. *Biomolecules* 2019; 9(6): 223.
26. Januszek R, Mika P, Konik A, Petriczek T, Nowobilski R, Nizankowski R. Effect of treadmill training on endothelial function and walking abilities in patients with peripheral arterial disease. *J Cardiol* 2014; 64(2): 145-51.
27. Lakka TA, Lakka HM, Rankinen T, Leon AS, Rao DC, Skinner JS, et al. Effect of exercise training on plasma levels of C-reactive protein in healthy adults: The HERITAGE Family Study. *Eur Heart J* 2005; 26(19): 2018-25.
28. Dow CA, Thomson CA, Flatt SW, Sherwood NE, Pakiz B, Rock CL. Predictors of improvement in cardiometabolic risk factors with weight loss in women. *J Am Heart Assoc* 2013; 2(6): e000152.
29. Fedewa MV, Hathaway ED, Ward-Ritacco CL. Effect of exercise training on C reactive protein: a systematic review and meta-analysis of randomised and non-randomised controlled trials. *Br J Sports Med* 2017; 51(8): 670-6.
30. Fedewa MV, Hathaway ED, Higgins S, Forehand RL, Schmidt MD, Evans EM. Moderate, but not vigorous, intensity exercise training reduces C-reactive protein. *Acta Cardiol* 2018; 73(3): 283-90.

آیا یک دوره تمرین هوازی بر وضعیت التهابی و عوامل خطر قلبی- متابولیسی زنان مصرف کننده قلیان تأثیر می گذارد؟ نتایج یک مطالعه مقطعی

عباس صارمی^۱، محمد پرستش^۱، منیژه توانگر^۱

مقاله پژوهشی

چکیده

مقدمه: مصرف قلیان، یکی از عوامل اصلی خطر التهاب و بیماری‌های قلبی- عروقی می‌باشد. هدف از انجام پژوهش حاضر، بررسی تأثیر دو ماه تمرین هوازی بر نیمرخ متابولیک و سطح پروتئین واکنشگر C (CRP یا C-reactive protein) در زنان مصرف کننده قلیان بود.

روش‌ها: در این مطالعه نیمه تجربی با طرح پیش‌آزمون- پس‌آزمون، ۲۲ زن مصرف کننده قلیان (حداقل دو بار در هفته) که از نظر سن (۲۷/۸۲ ± ۳/۸۱ سال) و شاخص توده بدنی (۲۶/۶۶ ± ۵/۹۲ کیلوگرم بر مترمربع) همسان بودند، انتخاب شدند و به طور تصادفی به دو گروه تمرین هوازی + کشیدن قلیان (۱۱ نفر) و کشیدن قلیان (۱۱ نفر) قرار گرفتند. همچنین، یک گروه شاهد همسان از زنان غیر سیگاری (۱۰ نفر) با میانگین سنی ۲۷/۱۱ ± ۲/۷۱ سال و میانگین شاخص توده بدنی ۲۶/۲۰ ± ۲/۳۹ کیلوگرم بر مترمربع) به منظور مقایسه در سطح پایه انتخاب شدند. برنامه تمرین هوازی سه روز در هفته، ۳۵-۵۰ دقیقه در روز و به مدت ۸ هفته انجام شد. از گروه شاهد درخواست شد که به زندگی عادی خود ادامه دهند. سطح سرمی CRP و عوامل خطر متابولیسی قبل و پس از مداخله اندازه‌گیری گردید. داده‌ها با استفاده از آزمون Paired t مورد تجزیه و تحلیل قرار گرفت.

یافته‌ها: در سطح پایه، شرکت کنندگان غیر سیگاری از نظر سطح CRP ($P = ۰/۰۰۱$) و درصد اشباع اکسیژن ($P = ۰/۰۲۰$) به طور معنی‌داری نسبت به زنان مصرف کننده قلیان از وضعیت بهتری برخوردار بودند. پس از ۸ هفته تمرین هوازی، هیچ تغییر معنی‌داری در نیمرخ لیپیدی زنان مصرف کننده قلیان مشاهده نشد ($P > ۰/۰۵۰$)، اما وزن بدن ($P = ۰/۰۴۰$)، آمادگی هوازی ($P = ۰/۰۱۰$) و سطح CRP ($P = ۰/۰۴۰$) در پاسخ به ورزش هوازی به طور معنی‌داری بهبود یافت.

نتیجه‌گیری: یک دوره برنامه ورزشی هوازی، آمادگی هوازی زنان مصرف کننده قلیان را بهبود می‌بخشد. این بهبودی بدون تغییر معنی‌دار در نیمرخ چربی پلاسما و با کاهش سطح سرمی CRP همراه بود.

واژگان کلیدی: تمرین؛ التهاب؛ قلیان کشیدن؛ زنان

ارجاع: صارمی عباس، پرستش محمد، توانگر منیژه. آیا یک دوره تمرین هوازی بر وضعیت التهابی و عوامل خطر قلبی- متابولیسی زنان مصرف کننده قلیان تأثیر می گذارد؟ نتایج یک مطالعه مقطعی. مجله اعتیاد و سلامت ۱۴۰۰؛ ۱۴ (۱): ۲۶-۳۴.

تاریخ پذیرش: ۱۴۰۰/۸/۵

تاریخ دریافت: ۱۴۰۰/۶/۱

۱- گروه فیزیولوژی ورزشی، دانشکده علوم ورزشی، دانشگاه اراک، اراک، ایران

نویسنده مسؤول: عباس صارمی؛ گروه فیزیولوژی ورزشی، دانشکده علوم ورزشی، دانشگاه اراک، اراک، ایران