International Journal of Multiphysics
Volume 15, No. 4, 2021
ISSN: 1750-9548

The Effect of Physical Activity with Regard to Energy Expenditure on Blood Pressure in Overweight and Obese Male Students

Ahmad Kazemi

PhD student in exercise physiology, cardiovascular and respiratory orientation, Islamic Azad University of Boroujerd

Abstract

Introduction: The aim of the present study was to investigate the effect of physical activity with regard to energy expenditure on blood pressure in obese individuals. Materials and methods: The statistical population was male students of Azad University of Khorramabad Branch. Among these individuals, 30 male volunteers aged 25-45 years, overweight and obese with an average body mass index of 29.3 kg/m2, were selected by purposive sampling. The dependent t-test was used to examine the effect of exercise on dependent variables. In all tests, the error rate was calculated at the P<0.05 level. Findings: Analysis of the research data after 8 weeks showed that in the experimental group, the variables of weight, body mass index, maximum oxygen consumption, diastolic blood pressure, and mean blood pressure changed significantly compared to the baseline level. (P<0.05) While systolic blood pressure did not change significantly. In the control group, no significant changes were observed in any variables.

Keywords: physical activity, blood pressure, energy expenditure, obesity

Introduction

The city and industrial life have caused changes in today's lifestyle, many of which have negative effects on the health and well-being of the individual. Lack of a regular exercise program and inactivity are one of these consequences.(1)

Reduced physical activity and an inappropriate diet as an urban lifestyle are considered two important factors for overweight, so that today the prevalence of risk factors for cardiovascular diseases such as high blood pressure and weight gain is higher in urban areas than in rural areas.(3 ,2)

Abdominal obesity is a risk factor for coronary artery disease, stroke, and heart failure. The prevalence of obesity and obesity-related hypertension is associated with an increased risk of high cholesterol, insulin resistance, diabetes, and chronic kidney disease.(2)

Findings from the Hypertension Prevention Institute (4) suggest that moderate-intensity physical activity (3 to 6 m) on at least 2 to 3 days per week is appropriate for the general population to prevent hypertension. Lowering blood pressure through moderate-to-light exercise is particularly important for patients with hypertension. Low-intensity exercise is associated with a lower risk of cardiovascular disease than high-intensity exercise.(5)

Most physicians believe that a low-intensity exercise program is more beneficial, especially for the elderly. Patients can also more easily implement and maintain a low-intensity exercise program. Such factors, along with low cost, no drug side effects, and other cardiovascular benefits of exercise, increase patients' participation in exercise activities and lead to better blood pressure control.

Azadbakht et al., in a study of 4164 men in Tehran, reported a general obesity prevalence of 29% and reported a high prevalence of obesity, especially overweight, and low physical activity levels in urban Iranian men.(6)

Reduced energy expenditure and impaired fat oxidation, increased cholesterol, and insulin resistance are considered as the main components of metabolic syndrome, which are important factors associated with obesity. Metabolic syndrome is a complex clinical disorder characterized by metabolic and cardiovascular features. High

blood pressure, triglycerides, and low high-density lipoprotein cholesterol are all associated with obesity and define the metabolic syndrome. Metabolic syndrome predicts not only type 2 diabetes but also high blood pressure (7). High blood pressure is a component of the metabolic syndrome. Insulin resistance, abdominal obesity, atherogenic dyslipidemia, and hyperglycemia are among the most important risk factors for cardiovascular disease.(7)

In a review of 54 articles from 1986 to 2000 in 2419 adults, Welton et al. concluded that aerobic exercise, even of relatively low duration, frequency, and intensity, is highly effective in combination with lifestyle changes and antihypertensive drug therapy.(6)

During the 20th century, most research on the prevention and treatment of cardiovascular disease has been conducted through the assessment and intervention of several lifestyle-related risk factors. One of the important factors in this regard is physical activity and its positive effects on human health (7). Despite the positive changes that have been achieved in such research, it should be noted that in cross-sectional studies that are observational and retrospective, the amount of recorded activity is usually exaggerated.(8)

The optimal intensity and duration of physical activity required to reduce cardiac risk factors have not been precisely determined (7). However, some studies have shown that the amount of energy expenditure of 1500 to 2200 kcal per week burned by exercise in sedentary individuals can have a significant impact on improving and maintaining the health of individuals.(9,10)

One of the points discussed in research related to the effect of exercise on cardiac risk factors is the amount of activity required (kilocalories burned and energy expenditure) to produce positive changes in these factors. What is important in this research is whether the total volume of exercise (total calories burned) has a positive effect on improving cardiovascular risk factors.

Materials and Methods

The research design was semi-experimental and the statistical population was the visitors to sports clubs in Khorramabad city. Among these individuals, 30 male volunteers aged 30-45 years, overweight and obese with an average body mass index of 29.3 kg/m2 were selected by purposive sampling. The statistical samples did not suffer from any of the coronary artery diseases, diabetes, renal failure, and thyroid diseases and had the appropriate conditions to participate in the study, and none of the subjects were smokers (according to personal statements).

All participants were aware of the research design and therefore each signed a personal consent form to participate in the design and blood sampling. The maximum oxygen consumption of the subjects was measured two weeks before the implementation of the protocol by the Pellequin test. The subjects were advised to observe their daily food consumption (dietary habits) normally during the training protocol and until the end of the sampling and not to make any obvious changes in their diet.

The exercise protocol included running at 65% of maximum heart rate on a treadmill, each session was equal to 450 kcal, three sessions per week, for 8 weeks. The control group did not do any special activity and were engaged in their daily activities. All exercise activities were performed at the same time in the evening and at least 3 hours after lunch. Before the test, the subjects sat on a comfortable chair for 10 minutes to measure heart rate, blood pressure, and then baseline blood sampling. After 8 weeks of exercise, blood sampling and heart rate and blood pressure assessment were performed 48 hours after the last exercise session.

To examine the normality of the data, the Kolmogorov-Smirnov statistical test was used, and to examine the effect of exercise on dependent variables, the dependent t-test was used. In all tests, the error rate was calculated at the $P<0.05$ level. SPSS.17 statistical software was used to analyze the data.

Findings

Descriptive characteristics of the subjects are listed in Table 1. As can be seen, the average age of the subjects was 39, the average height was 177 and their average weight was 88 kg.

Analysis of the research data after 8 weeks showed that in the experimental group, the variables of weight, body mass index, maximum oxygen consumption, diastolic blood pressure and mean blood pressure had changed

significantly compared to the baseline level. ($P<0.05$) While systolic blood pressure did not change significantly. In the control group, no significant changes were observed in all variables (Table 2).

Discussion and Conclusion

The aim of the present study was to investigate the effect of a physical activity with regard to the amount of energy expenditure on the blood pressure of obese people. The results of the study showed that an energy expenditure of 450 kcal per session for 8 weeks was sufficient to produce significant changes in weight, body mass index, maximal oxygen consumption, diastolic blood pressure, and mean blood pressure, but this level of activity (450 kcal per session for 8 weeks) could not produce significant changes in systolic blood pressure.

In 1995 and 1997, Cruz et al. trained two groups of men with high blood lipids at two intensities of 50 and 80 percent of maximal oxygen consumption and an energy expenditure of 350 kcal per session. This study showed that this level of activity improved indicators such as weight, body mass index, blood pressure, and triglyceride levels, which is consistent with the findings of the present study (11, 12).

Warham et al. (2000) showed that there is a significant relationship between daily energy expenditure and blood pressure, meaning that as daily energy expenditure increases, blood pressure decreases. The results of this study are somewhat consistent with the results of the present study (13).

The mechanisms underlying the blood pressure response to exercise training are still controversial and unclear. It is currently believed that exercise training must act on a number of pathometrological mechanisms. Ultimately, this effect results in a decrease in peripheral resistance, cardiac output, or both. The general consensus is that the changes in blood pressure are independent of body weight or body composition and are influenced by diet (14, 15). Significant reductions in blood pressure have been observed after a single exercise session and after a few hours (3), and no significant reductions in blood pressure have been observed after four exercise sessions and at the end of four weeks of exercise (4). In some studies, reductions in blood pressure have been associated with peripheral resistance, sympathetic nerve activity, and plasma norepinephrine levels (16, 17). In contrast, some have suggested that an increase in peripheral resistance throughout the resting period, but a significant decrease in cardiac output, is the mechanism by which exercise training is associated with a decrease in peripheral resistance. is considered responsible for the reduction in blood pressure (18).

Exercise studies have also yielded inconsistent findings. A moderate reduction in cardiac output, a lower resting heart rate, and no change in peripheral resistance have been observed in hypertensive patients who engaged in moderate-intensity exercise (19). However, the group that exercised more intensely had a similar reduction in resting heart rate but a moderate reduction in peripheral resistance and no significant change in cardiac output (19).

Some studies have reported no reduction in peripheral resistance, cardiac output, or heart rate despite the reduction in blood pressure caused by exercise (4, 21). In fact, the reduction in blood pressure following exercise is due to a reduction in plasma volume and norepinephrine levels (3, 4). Meredith et al. have suggested that the reduction in plasma norepinephrine levels may be important for long-term maintenance of The duration of the blood pressure-lowering response to regular exercise. In this study, the reduction in norepinephrine was consistent with the reduction in blood pressure after four weeks of exercise training, while the initial reduction in blood pressure was associated with a reduction in peripheral resistance after only four sessions of exercise training. A reduction in total peripheral resistance was also observed in patients with stage III hypertension (10). With the improvement of endothelial function, it is another mediator and factor in the blood pressure-lowering response to exercise. An increase in the hypertonic response following exercise has also been observed in patients with hypertension (22, 23).

Given that physical activity has been proven to be beneficial in improving health, especially in relation to cardiovascular diseases, it is recommended that, in cooperation with the Physical Education Organization and the Ministry of Health, sports medicine clinics be established under the supervision of sports experts and physicians for the non-pharmacological treatment of diseases such as high blood lipids and mild hypertension that can be treated without the use of drugs. This will both reduce the huge costs related to drug use for the country and patients, and promote sports and physical activity as a non-pharmacological treatment.

Resources

[1] Brock CM, King DS, Wofford MR, Harrell TK. Exercise, insulin resistance, and hypertension: a complex relationship. 2005. 3: 60-5.

[2] Narkiewisz K. Obesity and hypertension, the issue is more complex than we thought. Nephrol Dial Transplant. 2006. 21: 264-7.

[3] Chanudet X, Lambert C, Bonnevie L. Physical activity in hypertension management. Press Med. 2006. 35:1081-7.

[4] Haapanen N, Vouri I, Oja P. Association of leisure time physical activity with the risk of coronary heart diseases , hypertension and diabetes in middle age men and women. Int J Epidemiology. 1997. 26; 739-747.

[5] Matsusaki M, Ideka M et al. Influence of workload on the antihypertensive effect of exercise. Clin Exp Pharm Physiol. 1992. 19; 471-479.

[6] Rahimian Mashhad Ziba, Attarzadeh Hosseini Seyed Reza, Ariannejad Javad. The effect of aerobic exercise program and diet on cardiovascular risk factors and blood pressure in overweight, obese and hypertensive patients. Iranian Journal of Endocrinology and Metabolism. 2010. Volume 12, Issue 4, pp. 376-384.

[7] Cheung BM, Wat NM, Man YB, Cheng CH. Relationship between the metabolic syndrome and the development of hypertension in the Hong Kong cardio vascular risk factor prevalence study. Am J Hypertense. 2008. 21: 17-22.

[8] Lynn Wolf D. The effect of exercise training and dietary supplementation on fat metabolism and body composition in obese women. 2006. A Dissertation for the degree of Doctor of Philosophy. University of Pittsburgh.

[9] Kokkinos RF, Holland JC, et al. Miles run per week and high density lipoprotein cholesterol levels in healthy, middle aged men. Arch Intern Med. 1995. 155: 415-420.

[10] Williams P. Relationship of distance run per week to coronary heart disease risk factors in 8283 male runners. The National Runners Health Study. Arch Intern Med. 1997. 157: 191-198.

[11] Crouse SF, O'Brein BC, Granjean PW, et al. Training intensity, blood lipids and apolipoproteins in men with high cholesterol. J Appl Physiol. 1997. 2: 270-277.

[12] Crouse SF, O'Brein BC, Granjean PW, et al. Changes in serum lipids and apolipoproteins after exercise in men with high cholesterol: influence of intensity. J Appl Physiol. . 1995. 79: 279-286.

[13] Wareham NJ, Wong MY, et al. Quantifying the association between habitual energy expenditure and blood pressure. Int J epidmiol. . 2000. 29: 655-60.

[14] American college of sports medicine. Physical activity, physical fitness and hypertension. Med Sci Sports exerc, 1993, 25 (10); i-x .

[15] Motoyama M, Sunami Y, Kinoshita F et al. Blood pressure lowering effect of low intensity aerobic training in elderly hypertensive patients. Med Sci Sport Exerc. 1998. 30; 818-823.

[16] American college of sports medicine. ACSM 's guidelines for exercise testing and prescription. 6th ed. Baltimor. Lippincott Williams & Wilkins, 2000 .

[17] Cononie CC, Graves JE, Pollock MR. effects of exercise training on blood pressure. Med Sci Sports exerc. 1991, 23(4); 505-511.

[18] Hagberg JM, Brown MD. Does exercise training play a role in the treatment of essential hypertension? J Cardiovask risk. 1995. 2; 296-302 .

[19]Kokkinos PF, Narayan P. Effects of regular exercise on blood pressure and left ventricular hypertrophy in Aferican American men with severe hypertension. N Eng 1 Med. 1995. 333; 1462-1467 .

[20] National High Blood pressure Education Program Group. Prevention of hypertension. Arch Intern Med. 1993. 153; 186-208.

[21] Staessen J, Amery A. Life style as a determinant of blood pressure in the general population. Am J Hypertens. 1994. 7;685-694 .

[22] Friedwald VE, Spence DW. Sudden cardiac death associated with exercise. Am J Cardiol, 1990, 66; 183-188.

[23]Hurley BF, Roth SM. Strength training in elderly: Effects on risk factors for age related diseases. Ports Medicine. 2000. 4; 249-265 .

Table 1, Descriptive characteristics of subjects

Domain	Mean – Standard Deviation	Characteristics
45-25	39/5±1	Age (years)
186-165	177/8±4	Height (centimeters)
99--79	87/7±9/2	Weight (kilograms)
63-82	6±78/5	Resting heart rate

Table 2, Changes after 8 weeks of training

Significance level	Post-test	Pre-test	Groups	Variables
0/04	83/6±1/2	87/5±6	Experimental	Weight (kg)
0/9	88/7±2	86/7±4/1	Control	
0/042	27/3±3	30/3±1/1	Experimental	Body mass index m2/kg
0/91	29/2±6/1	29/4±4/2	Control	
0/012	34/6±4	29/5±1	Experimental	Maximum oxygen consumption
0/91	29/7±7/4	30/4±3/5	Control	$ml/kg/min^{-1}$
0/09	9±125	12±131	Experimental	(mmHg) Systolic blood pressure
0/46	13±132	11±129	Control	
0/04	5±84/6	7±89	Experimental	Diastolic blood pressure
	9±88/3	89/8±8/6	Control	(mmHg)
0/045	6±103	9±108	Experimental	Mean blood pressure
0/93	8±105/7	7±103/6	Control	(mmHg)